

METAL INDUSTRY

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Aluminium in Western Germany

SOME interesting facts relating to the production and consumption of aluminium in Western Germany may be obtained from the annual report recently presented to the annual general meeting of Vereinigte Aluminium-Werke A.G. by its board of directors. It would seem that the West German economy has not remained unaffected by the weakening of international economic expansion, and the annual rate of growth of the national product and the output of capital goods were both smaller in the period of 1957 than in previous years. In these circumstances, therefore, it was hardly to be expected that aluminium consumption in Western Germany should show an appreciable rise such as that achieved in the years 1953-1955, when the percentage rise was between 7 and 12 per cent for the three years. The rise in 1957 was 4 per cent. The increase in the consumption of aluminium remained at the previous year's figure of 2 per cent, and affected only virgin aluminium. Consumption in 1957 is reported at 274,000 metric tons, and for the current year (1958) it is expected to reach 285,000 tons. Of last year's total figure, 154,000 tons was home-produced primary aluminium from virgin metal, and of this amount Vereinigte Aluminium-Werke accounted for 72 per cent.

A cautious appreciation of developments caused the aluminium-using industry in the country to exercise restraint in building up stocks, and as early as the middle of 1956 it began using up stocks of semi-finished products accumulated during the period of aluminium shortage. West German output in 1957 amounted to 153,800 metric tons of virgin aluminium, compared with 147,000 tons in the previous year. Imports amounted to approximately 39,000 metric tons, of which about 62 per cent came from Canada and Norway, 23 per cent from Austria, and 5 per cent from the Eastern Bloc. As in the previous years, the whole of aluminium imports entered the country free of duty, as part of the duty-free quota and on the drawback system. Stocks of virgin metal have shown an increase during the current year, particularly at the smelting end, owing to the 6.7 per cent rise in imports and a 4 per cent advance in aluminium production. There were adequate supplies of secondary aluminium in the country, since production had risen from 87,200 metric tons in 1956 to 89,700 tons last year, although prices had yielded under pressure. The aluminium-using industry also managed to achieve a slight rise in the output of semi-finished products and castings, of 2.3 and 2.6 per cent respectively. Foil production, on the other hand, showed an advance of 11.3 per cent.

Sharp price cuts by foreign producers since the end of 1957 are said to have had a seriously adverse effect upon the Germany industry. In July last, German aluminium cost DM. 2.23 per kilogramme, against DM. 2.08 for Canadian and DM 1.90 for East European supplies. In these circumstances, imports are expected to reach 60,000 tons or more this year. Apparently, producers in Western Germany have asked for greater protection for the industry but so far no official steps have been taken in this direction.

Out of the **MELTING POT**

Help !

QUITE a lot has been said about the delays that always seem to intervene between the discoveries made in the course of pure or fundamental research, or just chance discoveries or inventions, and the application of such discoveries and inventions to useful purposes. Much less, if, in fact, anything at all, appears to have been said about the disadvantages, so far as the pure research is concerned, of too long an absence of practical applications. In the absence of such applications, and of the consequent need of keeping at least one foot firmly on the ground, research tends to run riot in all sorts of possible and impossible directions. The resulting accumulations of hypotheses, theories, and usually unco-ordinated if not actually conflicting results, very quickly effectively obscure any intrinsic practical interest the subject may originally have appeared to possess. An excellent (if excellent is the word) example of such a development is provided by the field of metal whiskers and thin films. Metal whiskers were a chance discovery made some years ago in connection with the investigation of the erratic behaviour of certain electrical equipment as a result of "short-circuiting" by the hitherto unsuspected filamentary growths on the plated metal surfaces. The interest created by the discovery, and the excitement caused by the observation soon after of the very high elastic properties of metal whiskers, failing in due course to find an outlet into practical channels, seem to have become progressively submerged in a flood of theorizing and academic experimentation concerned more with advancing the knowledge of the solid state than the throwing of light on practical possibilities. Much the same has happened to thin films and their unusual mechanical properties. Can somebody be found to break through the formidable academic barrier that has been built up and, disregarding dislocation mechanisms and the rest, to get down to the volume production of whiskers and thin films, and to their utilization by the techniques of fibre metallurgy on the one hand and foil metallurgy on the other?

Fine Probing

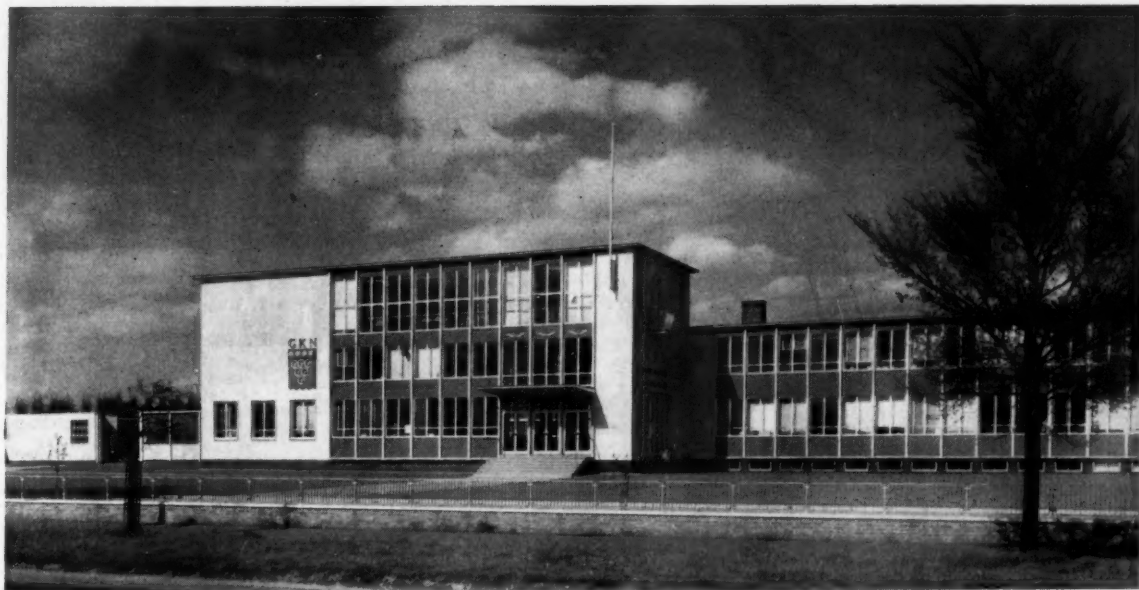
SOME of the familiar do's and don'ts and difficulties attaching to any experimental approach to a problem are to be noticed in a preliminary investigation of thin film lubrication by a method involving electrical discharge across the oil film. In these experiments, a steel ball and a steel plate were both connected to a source of current, and current/voltage curves were obtained with (a) the ball resting on the steel plate, and (b) the ball separated from the plate by a small known distance and with the plate flooded with oil. In the first case, a straight line relation was obtained (Ohm's law). In the second, the curves were situated above the Ohm's law curve, and for currents above 0.5 amp were parallel to it. The distance between the Ohm's law line and the parallel portions of the curves obtained for case (b) is referred to as the discharge voltage. Its value was found to be independent of the type of oil, presumably due to the fact that under the conditions of electrical breakdown of the oil film, the current is carried by ionized molecules, and their characteristics should be independent of the molecular weight of the oil. Not surprisingly, however, this same fact, that

the method of measurement used affected the object being measured (electrical breakdown of the oil), resulted in oil film thickness values being obtained which seemed very large. This finally led to the abandonment of the static conditions, and the application of the electrical discharge method to the measurement of oil film thickness under dynamic conditions (shaft rotating between two contact plates adjustable for position and load). Under these conditions, the discharge voltage was independent of the viscosity of the oil, of the bearing load, and speed. The discharge voltage separation constant proved, however, to be sensitive to the purity of the oil, going up from 4.5 V/0.001 in. for unfiltered oil to 12 V/0.001 in. for oil carefully filtered through an edgewise filter. Applying the electrical breakdown method and the above results to a four-ball machine, the existence of a coherent oil film between the balls was demonstrated. Its thickness, e.g. 0.5×10^{-4} in. at a speed of 192 r.p.m. and a load of 40 lb., was surprisingly large. In spite of these and other insights provided by the method into the oil film lubrication conditions, one is left with the impression of misapplied sensitivity: the opposite, whatever the metaphor may be, of using a sledge hammer to crack a nut.

Into Line

GROWING mechanization, one might almost call it automation, of the process of scrapping products manufactured from metal should be of interest to other than just the scrap metal handling and using circles. The fact that in a plant recently demonstrated in America it is possible, to all intents and purposes, to feed in a motor car at one end and recover small pieces of clean metal at the other, shows how far metal product scrapping methods have advanced since the horse and cart, sledge hammer, oxy-acetylene and hand sorting days. From being hard, more or less skilled manual labour, scrapping has now virtually reached the status of a production process, and it is in this fact that its wider interest resides. Its new production status should enable the scrapping process to take its place on the same level and in line with other production and manufacturing processes, instead of remaining a useful ancillary operation. Integration of the scrapping process with production and manufacturing processes would result in the period of time during which the products were performing the service for which they were intended becoming no more than a stage of what would amount to a closed materials processing cycle. This would have a number of advantages. It would encourage more attention being paid to this hitherto much neglected service period, with special reference to its length and to the ways and means of controlling this length. It need hardly be pointed out that this would line up very well with the current trend from purchase to hire purchase and, ultimately, to hire without purchase. It would also line up with the trend from servicing, maintenance and repair to replacement. Finally, and most important, it would line up with the developing situation in which energy is likely to become more and more abundantly available, and materials less and less so.

Skimmer



G.K.N. Group Research Laboratory

By J. LOWNDES, A.I.M., A.C.T.(B'ham)

One of the main attractions of the Golden Jubilee Autumn Meeting of the Institute of Metals, to be held in Birmingham next month, is the opportunity it will afford of visiting a wide variety of works and laboratories. Among the latter is the group research laboratory described in this article, which in the scope of its activities is probably unique.

TO those who know the G.K.N. group of companies, their number, and the variety of their operations, the title of this article will have immediately raised the question of how a single research laboratory could adequately serve the needs of such a group. The answer lies in the fact that although this laboratory is the focal point for the longer term research and development work of the company, it is by no means the only point at which its technological future is safeguarded.

The group consists of some 83 companies, linked by many common ties, but with each operating very much as an autonomous unit and developing within the broad group framework under its own impetus, and on the initiative and foresight of its own commercial and technical management. In this atmosphere it is inevitable that each company will have its own technical men looking to the future, and in the larger companies, research and development departments, often linked closely with local control laboratories. The intimate knowledge that these men have of local conditions and works processes, coupled with their close proximity to company management and—it must be said—their freedom from cumbersome

central direction and control, can lead to excellent conditions for soundly based development and research; though the latter will always be strongly oriented and well confined within the immediate or easily foreseeable interests of the company.

The rate of scientific and technical progress to-day, however, demands that all industries look further and further ahead to discover processes that will enable their products to be made more cheaply, or to devise new or improved products within the broad confines of their industrial interests. These demands can be met adequately only in the largest companies, or in those whose activities have been based from the start on recent scientific developments, and whose products have been accepted as carrying a high development charge. The logical development for a group such as G.K.N. was, therefore, to set aside an organization separate from the immediate financial and technical demands of any one company, and devoted to research and development work which could conceivably be of benefit to large areas of the group's activity, or, if necessary, directed to parts where the need appeared to be greatest.

Such an organization—the G.K.N.

Group Research Laboratory—was brought into being in name in 1947. It has developed steadily over the years as more has been understood of the group's needs, and as it has learned how to tackle its job effectively. The laboratory has grown with the closest possible relations with the technical men and organizations in group companies, and it is fair to say that in many ways it has stood on their shoulders. A research laboratory must be a centre of creative thinking, and as such must originate much of the work which it carries out. But in industrial research this work can be sensibly oriented only if there is close contact with the production departments, and understanding between the man in the research laboratory and his opposite number in the works. The ultimate end of industrial research must be industrial production, and it is the technical man in the works who will eventually translate the findings of the research laboratory into the new product or the new process on the shop floor.

Thus, we have the picture of a large group of companies whose activities range from steelmaking to the production of safety pins, each to a greater or lesser degree carrying out its own forward thinking and development, but having at its disposal the resources of a central research and development laboratory whose management and personnel are in close contact with the activities, the thoughts and aspirations

of the local technical people. There are many ways in which these contacts are formalized — through advisory committees, a widely representative research board, and so on—but perhaps the most important lines of communication are the informal ones, which are built up only over a period of time and are based on mutual confidence.

Functions

Much has been said and written on the general functions of industrial research and development organizations, and generalizations are almost impossible; each industry or group of industries has its own problems, and organizes forward thinking and experimentation to suit its own particular circumstances. The accent to-day is generally on team work, the group of people with a basic training, probably in a number of different disciplines, who tackle collectively a specific problem. Four hundred years ago Francis Bacon described in his "New Atlantis" a country which supported a large research foundation, the object of which was to determine "The knowledge of causes and of the unexplained behaviour of things; and the enlarging of the boundaries of human ability to make all things possible." The functioning of the organization is described partly as follows—"We have three that try new experiments, such as they think good . . . three that write up the results of the experiments . . . three that spend their time looking into the experiments of their fellows, and to try and draw out of them things of use, and practice for men's life and knowledge."

"Then after diverse meetings and consultations of our whole number to consider the former labours and collections, we have three that discuss new experiments more penetrating into nature than the former. We have three others that execute the experiments so discussed and report them. Lastly, we have three that raise the

former discoveries by experiments into greater observations, axioms, and aphorisms."

Although expressed in very different terms from those which would be used to-day, that description embraces a great deal of the functions of a research and development organization as we know it.

The industrial research and development organization must, therefore, maintain a balance between the theoretical and the practical. There must be highly qualified and mainly theoretical scientists who can not only originate and pursue advanced theories and experiments, but also understand and maintain contact with the work of their colleagues in pure research institutions. And there must be the practical men, with some experience of industry and how it works; capable of appreciating the more theoretical work of their colleagues and able to visualize how it can be successfully applied in industry. It is the creation and maintenance of this balance which is one of the great keys to success in industrial research and development.

Broadly defined, then, the functions of the Group Research Laboratory are to help maintain the economic health and to safeguard the future prosperity of the group by devising, in close collaboration with the technical personnel at all levels in group companies, better processes for the manufacture of existing products, and new or better products for manufacture within the broad context of the group's activities.

High Level Direction

The laboratory is a part of G.K.N. Group Services Ltd., and the widest possible contact with the group as a whole is assured from the highest level. The broad policy of the organization is governed by a research board, whose 14 members are mainly executive directors of group companies, and whose chairman is a member of the G.K.N. board. More detailed matters are dealt with by a smaller

executive committee, composed of six representatives, mainly of technical management throughout the group, and the managers of the five divisions of the laboratory. The director of research is a member of both bodies, and has much the same freedoms and responsibilities as the managing director of a manufacturing company. Thus is ensured from the outset a close and realistic contact with both commercial and technical aspects of group direction. The research board has the combined duties of advising the G.K.N. board of the research and development needs of the group, and of guiding the operations and development of its main research establishment.

Laboratory Organization

In common with the majority of similar organizations, the G.K.N. Group Research Laboratory has grown slowly from a relatively small nucleus. The rate of growth has depended on two factors; the needs of the group, and the rate at which the laboratory could crystallize programmes of work to meet these needs and assemble suitable facilities and staff to tackle them. During the early years of growth the internal organization has, of necessity, been continually changing to meet varying demands and circumstances, and there is no reason to suppose that this process will ever cease. What is required is a structure sufficiently formal and stable to ensure effective administration and control, and yet flexible enough to meet fairly rapidly-changing demands and new commitments. While there must be a good deal of continuity in the longer term work, an industrial laboratory must always be ready to meet short-term demands of a very varied nature.

The nucleus of the laboratory was a small research organization established in 1945 in Joseph Sankey's Manor Works, Bilston (a G.K.N. Group Company). This organization is devoted mainly to the manufacture

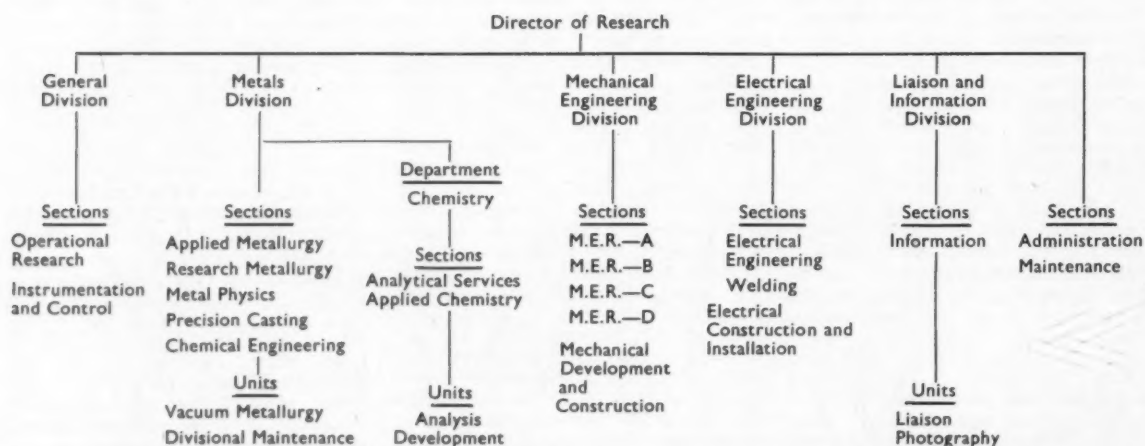


Fig. 1—The pattern of organization of the Group Research Laboratory. There is a total staff of 180, including 70 graduates and 35 student apprentices

and testing of silicon iron sheets for electrical purposes. In 1947 it was decided to extend this unit to serve the G.K.N. Group as a whole, and plans were laid for a completely new building on a separate site.

The present organization can be illustrated by Fig. 1, though it must be remembered that this is only the essential skeleton on which the real body of the organization is built, and shows nothing of the inter-divisional collaboration, or the mixed teams that exist to tackle some projects.

The activities of the laboratory are best described by reference to the above structure, and a brief account of the facilities and the work of each division is contained in the ensuing description. Rather than attempt a detailed description of either, a number of the main projects are outlined and illustrated, when most of the facilities will automatically become apparent.

The Building

The main block of the building, which faces the Birmingham New Road and was occupied in 1953, houses the lighter research activities, the library, and service sections. The gross floor area is 36,722 ft², of which approximately one-third is operational, one-third service and administrative, and one-third circulation space. The building is of considerable architectural merit, and was awarded an R.I.B.A. bronze medal in 1957.

The heavier activities are carried out in a separate building at the rear of the site; this was a later addition com-

pleted in 1956. It is a steel frame building designed according to Baker's plastic theory of structures, and provides 12,295 ft² of floor space, of which about three-quarters is operational, the remainder being stores, thoroughfares, etc. A further extension now nearing completion will add 11,000 ft², and includes a separate air-conditioned laboratory for creep testing.

Metals Division

Since the majority of group activities concern the manufacture and manipulation of steel, it is not surprising to find a strong division devoted to a study of many aspects of metallurgy.

In the early days of the laboratory, the heaviest demand was for work on day-to-day problems on materials and processes, and under this stimulus the Metals Division grew rapidly, both in size and in the range of its activities. While the emphasis has naturally moved with the years towards the type of research and development work more suited to a central laboratory, service work and technical enquiries still occupy a prominent place in the division's activities. The work is organized under seven sections:—research metallurgy; applied metallurgy; casting; metal physics; chemical engineering; applied chemistry; analytical services. The two latter sections are grouped as a chemistry division.

Research Metallurgy

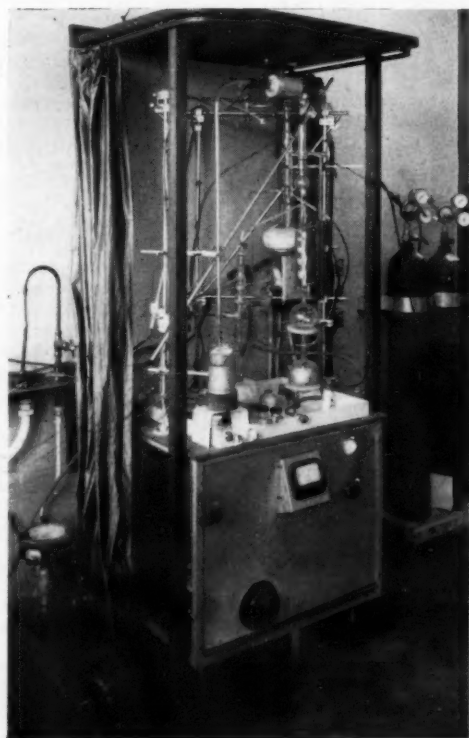
This section has the main responsibility for longer term research work,

either originated in the section itself or, more frequently, inspired by some limitation to existing knowledge which has become apparent in other parts of the laboratory or in the Group. The current activities include investigations into the cold working of mild steel in relation to its transition temperature, the formation and properties of scale on wire rod, and the influence of scale on carburization and decarburization; a study of the mechanism of hydrogen embrittlement caused by pickling and plating, and the development of specialized plating solutions.

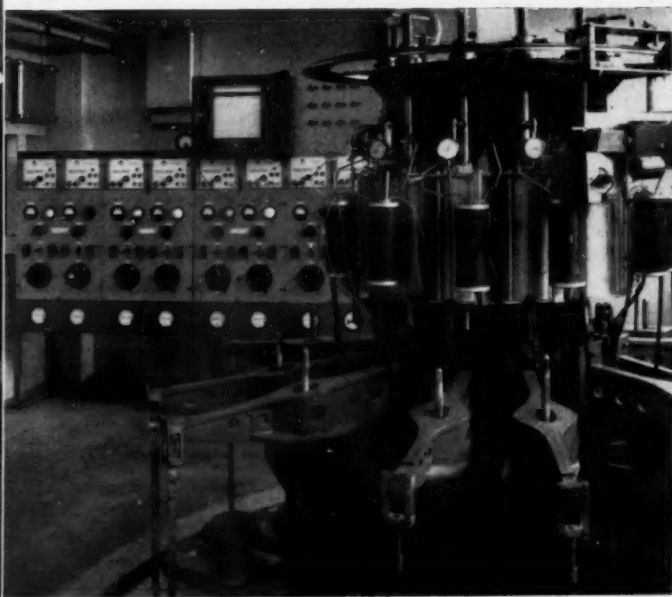
The demand for more extensive knowledge of the high temperature properties of materials has led to the establishment of a creep testing unit, which is soon to be expanded in more suitable premises, and this activity is also the responsibility of the research metallurgy section.

Applied Metallurgy

As the title indicates, this section is concerned more with shorter term development activities in the metallurgical field, and in addition to several major projects, it deals with many technical enquiries from group companies, usually involving no more than a few weeks' work at the most, but whose results can be of inestimable value to the manufacturing companies. This section has been responsible for research and development work leading to the production of high strength titanium alloy fasteners. The laboratory work has been carried out in close



Left : Fig. 2—Apparatus for determining the hydrogen content of steel



Below : Fig. 3—Part of the creep testing laboratory

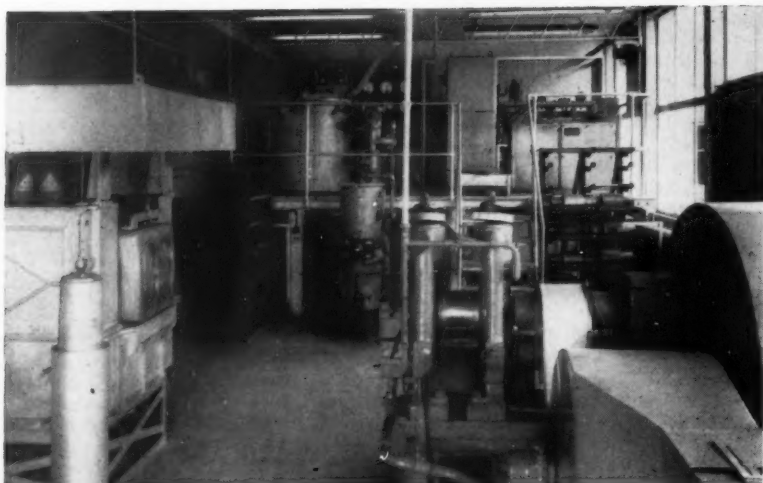


Fig. 4—Vacuum melting unit and rolling mill

Fig. 5—Experimental foundry



collaboration with the appropriate group company, which is now in a position to manufacture. Other examples of the section's work include the examination of non-metallic inclusions in steel, including methods of assessment, possible sources, and possible means of reduction; another project where there is close collaboration with the works, to the extent of having one of the laboratory staff resident at a group steel works for an extended period.

Casting

The existence of this section bears witness to the extent to which the laboratory structure must be flexible. Arising from an interest in the possibility of reducing the cost of complicated forging dies which are normally produced by machining, the activities and interest in the precision casting of steel led to the development of a team

which it was administratively convenient to organize as a separate section. It also includes a limited amount of work on vacuum metallurgy.

The section has facilities for melting 1 cwt. heats in air, and melting and casting up to 10 lb. in vacuum, or controlled atmosphere. Moulding techniques include Shaw, CO₂ and shell, on all of which a certain amount of development work is being carried out. A wide range of tools and dies has been cast for production trials in the works, and many encouraging results have been achieved. Interest has not been confined to tools and dies, and recently a number of machine components has been produced.

Recent work on vacuum metallurgy has involved a limited study of the influence of vacuum melting and casting on established high temperature materials, and on Stellite 31.

(To be continued)

Obituary

Col. J. W. Danielsen

WE regret to record the death of Colonel John W. Danielsen, until March of this year chairman of Deritend Stamping Co. Ltd. He had been a director of the company for 56 years. Educated at Wolverhampton Grammar School, he was apprenticed to mechanical engineering, and later held positions with B.S.A. and other firms. He later became managing director of the Deritend Stamping Co. In 1919 he was appointed chairman, and on the amalgamation of the company with the Blackheath Stamping Company and the South Wales Forge Masters, he became chairman of the group and commercial director.

Col. Danielsen took a major part in the formation of the National Association of Drop Forgers and Stampers, of which he became President. He was a former President of the Birmingham Association of Mechanical Engineers, and a former chairman of the Midland branch of the Institution of Mechanical Engineers.

Mr. W. N. Mann

WE also regret to record the death of Mr. Walter N. Mann, a former director of Panelec (Great Britain) Limited. Mr. Mann was the first general manager of Electric Panels Limited and later, when the name was changed to Panelec (Great Britain) Limited, he served on the board until his retirement in March this year. After retirement, he was retained as heating consultant to the company.

Mr. F. B. Rice-Oxley

WE also record with regret the death of Mr. Francis Bowyer Rice-Oxley, managing editor of our contemporary, *Metal Bulletin*, since 1934. He was also managing director of Metal Information Bureau Ltd. and Quin Press Ltd.

Gas Determinations

DETERMINATION of gases in metals has become a problem not only to metallurgists and metals chemists, but also to engineers in applied fields. A Symposium covering the determination of gases in metals has been published by the American Society for Testing Materials.

The Papers are: "Bromination-Carbon Reduction Method for the Determination of Oxygen in Metals"; "Emission Spectrometric Determination of Oxygen in Metals"; "Two Apparati for the Determination of Gases in Metals"; "Application of Vacuum Fusion to Gas-Metal Studies"; "Oxygen Determination Using a Platinum Bath and Capillary Trap."

Copies of this book may be obtained from A.S.T.M. Headquarters, 1916 Race Street, Philadelphia 3, Pa., at \$2.20 each.

Research Progress

Removal of Internal Flaws

BY RECORDER

IT is clear that in the manufacture of metal components, the rejection of material containing unacceptable flaws should, for economic reasons, occur at the earliest possible stage of the processing. This, in general, will be after casting the ingot, billet or rough shape and prior to any mechanical working of the piece. Advances in non-destructive testing and control techniques have, in many industries, led to the desired reduction in the numbers of defective ingots, etc., passed for further operations. In the case of stock for rolling or for extrusion, for example, the detection of cavities close to the surfaces of the ingot is often important in reducing the later formation of blisters on the rolled or extruded product which arise from the action of entrapped gases on the thin surface layer of metal.

The production of ingot or billet stock completely free from defects, in particular porosity, is, however, difficult: furthermore, it is not always certain that any cavity in any position in the stock will have a deleterious influence on the properties of the finished component. For instance, it can be imagined that in tube production a certain amount of axial unsoundness could be permitted if this region were to be punched out in subsequent processing. There is also the possibility that some types of deformation will tend to close up cavities located in favourable parts of the stock. The amount of work carried out to determine in which instances internal flaws are removed by processing appears to be very limited, and a recent Paper by A. Tomlinson and J. D. Stringer¹ is, therefore, to be welcomed.

These authors are on the staff of the British Iron and Steel Research Association, so they were concerned only with ferrous practice, and, indeed, all their experiments were on mild steel. Their results cannot, then, be used directly by non-ferrous industry generally, but should give a useful guide to what might be attainable by those manufacturers.

Effects of Upset Boring

The B.I.S.R.A. investigation was directed toward the determination of the effects of upset forging ("upsetting") on axial shrinkage cavities. The latter were simulated in initial tests by drilling axial holes to within $\frac{1}{2}$ in. of the bottom of 4 in. square blocks, the open end of the hole then being plugged. Details of this operation are not given, so it must be assumed that its object was to provide

an airtight seal and that this was invariably accomplished.

The blocks, 4 in. or 8 in. long, were forged between flat tools on a 200 ton press at 1,200°-1,250°C. A "nominal penetration speed" of $1\frac{1}{2}$ in./sec. was used, and this phraseology suggests that the press may have been accumulator-driven, in which case the actual speed would vary with the force required to deform the specimen. With $\frac{1}{2}$ in. dia. holes, closure commenced in the shorter blocks when the height had been reduced to 0.58 of the original and was apparently complete when the height had been reduced to about 1.5 in. The holes closed first in the centre of the block, the portions nearest the top and bottom of the block being throughout the most persistent. The 8 in. long specimens gave similar results except that the upsetting required for a given degree of closure was greater than for the shorter blocks. Comparison of the height:diameter ratios revealed, however, that for both sizes of block, closure of the holes began when this ratio was approximately 1:2 and was completed at a ratio of about 1:4. Holes smaller than $\frac{1}{2}$ in. dia. were tried and gave similar results but closing a little sooner, e.g. a $\frac{1}{8}$ in. dia. hole began to close at a height:diameter ratio of 2:3.

Displacement of the hole up to $\frac{1}{2}$ in. from the axis did not significantly affect the relationship between height:diameter ratio and degree of closure. Larger offsets were not tried as being "not of practical interest," though the effect of upsetting on holes close to the unsupported surfaces would seem to be worth examining.

In the remaining tests, with flat tools, 4 in dia \times 8 in. long blocks, each having a tapered extension at one end to simulate an ingot "head" were used. Again, the central part of the hole sealed when the height:diameter ratio of the main body of the specimen had been reduced to about 0.5, and the remaining cavities disappeared progressively until at a ratio of about 0.25 little trace of them could be detected. It was, however, observed that in the first stages of forging these long specimens the central parts of the hole tended to expand, this enlargement persisting until the height:diameter ratio had been reduced to approximately unity.

The flat tools used in the above experiments gave a product which, if upsetting were continued to eliminate the central holes, was not suitable for reforging. Consequently, subsequent experiments were carried out with tools dished at an included angle of

120°, which gave a product easily reforged at right angles to the upsetting. Again, a relationship between the degree of closure of central holes and the height to diameter ratio was established, but here these parameters were not related linearly, possibly because the "height" had to be selected, owing to the geometry of the product, from projections of the conical surfaces of the use.

Short Axial Holes

Specimens were also tested to examine the behaviour of short axial holes. For this work, two-piece blocks were made up, the parts being welded together after drilling the desired hole in one surface. It was found that $\frac{1}{2}$ in. long $\frac{1}{2}$ in. dia. holes at the centre of 4 in. dia. 8 in. long blocks behaved in exactly the same way as the central region of longer holes. Short $\frac{1}{2}$ in. dia. holes placed centrally, however, after first increasing in diameter and shortening as expected, welded end to end on more severe upsetting without any apparent diametral contraction. Short axial holes, $\frac{1}{2}$ in. dia., situated near the surface of the block, closed in a similar fashion to the ends of long holes.

Other composite ingots were made up by welding together four cylindrical pieces. Tensile tests were made on such specimens after upsetting, and after upsetting and reforging. It was found that, although after upsetting only the ductility was low compared with that of solid upset stock and that fracture occurred at a weld position, the properties of reforged samples were satisfactory and fracture did not apparently occur at a weld. The authors conclude that the welding of holes during upsetting, if followed by subsequent deformation, does not leave a source of weakness in the material. This suggestion should, however, be taken to apply only to straightforward tensile conditions, as it seems possible that oxide films formed on the hole surfaces and sealed into the metal could act as stress raisers in certain cases, e.g. in notched impact or fatigue.

Tomlinson and Singer discuss the mechanism by which axial holes could be closed by upsetting, and ascribe their results to frictional effects between the tools and the block. They suggest that initially the metal nearest the tools is held in restraint by friction though the central regions can follow general metal movement and contract in height whilst expanding in diameter. When the volume affected by friction

(Continued on page 174)

Readers' Digest

FATIGUE OF METALS

"The Proceedings of the International Conference on Fatigue of Metals, 1956." Published by The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London, S.W.1. Pp. 961 + v. Price 90s. 0d.

FEW aspects of modern technology and scientific development present at one and the same time such a theoretically diverse and yet generally applicable practical problem as does the subject of metal fatigue. This subject has, since the early twentieth century, received ever-increasing investigation from both the standpoints of basic knowledge and its engineering significance, and international conferences were held in 1946 (Melbourne) and 1950 (Massachusetts). The 1956 conference, therefore, had as its principal objective the focussing of recent progress in knowledge, both basic and applied, together with the obtaining from the engineering industries of an indication of their present and future needs.

The conference of 1956 was based on 81 Papers, designed to contribute to every aspect of fatigue and presented for discussion both in London and New York. In London, these Papers were discussed in eight sessions under the headings of Stress Distribution (two sessions); Temperature, Frequency and Environment; Metallurgical Aspects of Fatigue; Basic Aspects of Fatigue; Engineering and Industrial Significance of Fatigue (three sessions). The reporters summarized the Papers before the discussions were officially opened. In New York the same system was adopted, but the grouping of Papers was somewhat different.

The conference volume records the short opening session (not discussed), introductory address, the reporter's introduction, discussions and plenary sessions, both in London and New York, together with communications and authors' replies. The volume is opened with an editorial introduction, and concluded with useful and extensive name and subject indexes. The 81 Papers which form the bulk of the volume are grouped according to the London discussions, in which form they will be very briefly reviewed.

The Papers comprising the first two sessions in London, and coming under the general heading of Stress Distribution, are of principal interest to the designer and engineer. Papers dealing with design detail in the production of engineering components, and with estimation of their service life, form a useful contribution to future design. A novel Paper by Head and Hooke, entitled "Random Noise Fatigue Testing," describes the results obtained

during irregular stressing in alternate bending.

The Paper by Allen and Forrest in Session 4 on Temperature, Frequency and Environment, forms interesting reading of a general nature to the metallurgist. It embraces ferrous and non-ferrous metallurgy, dealing mainly with the influence of temperature. The other Papers in the section are of a much more specific nature, and include a novel method of testing at very high frequencies reported in a Paper by Lomas, Ward, Rait and Colbeck. The results obtained show that as the frequency of testing was increased on four engineering steels stressed in alternating bending at resonance, an increase of endurance limit was followed by a decrease in this value. In his Paper "Corrosion Fatigue," Gould emphasizes that corrosion fatigue is always present and shows that it can be reduced by specific surface treatments. This section also includes two Papers dealing with fretting corrosion, a problem of ever-increasing practical importance.

Discussion on ten Papers (seven ferrous and three non-ferrous) form the London Session on the Metallurgical Aspects of Fatigue. As the metallurgical problems are highly individual to the materials investigated, no general conclusions can be drawn. The Paper by Frith on the "Fatigue of Wrought High Tensile Alloy Steels" deserves special mention, as the tabulated results (including work of other investigators) form a useful reference. As opposed to this long Paper, a short Paper by Tipler and Forest is also of extreme interest, as it records inter-crystalline fatigue failure in an extremely embrittled sample of iron. The effect of carbon content, inclusions and hydrogen absorption in steels form the basis of other Papers in this Session. The non-ferrous aspect deals with specific investigations of lead and its alloys, copper and its alloys, bearing metals, high strength aluminium, and a basic study by Jacquet of 67 per cent copper brass.

The Papers presented under Basic Aspects of Fatigue can be divided into three groups, namely, quantitative studies, practical significance of the fatigue crack, including propagating and non-propagating cracks, and the nature of strain hardening, including slip bands and the interrelation between crystalline structure and cracking. Again, the Papers are specific in nature and emphasise certain aspects rather than giving a general body of fundamental knowledge.

The three sessions dealing with the Engineering and Industrial Significance of Fatigue were divided into General Service, Automobiles, and Specific Components, Airframes and Engines; Marine Engines, Railways

and Welding for discussion in London. The Papers included in these three sessions are highly specialized and if any unifying theme emerges, it is that poor design and ill-conceived repair, rather than a lack of basic metallurgical knowledge, contribute to the majority of service failures. The "fail safe" principle is adequately emphasized with regard to aircraft design.

Fatigue by thermally induced stresses, even if not generally recognized under the heading of metal fatigue, is reaching ever-increasing practical importance, particularly in the design of aircraft engines. Yet, apart from a section in the Paper by Allen and Forrest, little mention is made of this topic.

The conference volume does include a few editorial and typographical errors, but these are not sufficient to distract from the technical context. It is a pity, however, that some of the interesting detail is lost on a number of photomicrographs due to poor reproduction.

In conclusion, the conference volume has as its principal objective the recording in detail of the proceedings of the conference. This monumental editorial task has been well accomplished to form a valuable and up-to-date contribution to the subject of the fatigue of metals. Nevertheless, this volume is of limited general utility, since it deals largely with specific cases and does not form easy or general reading.

J. B.

Research Progress

—continued from page 173

increases to the point where the effects of top and bottom faces interact in the central regions, the hole begins to close, a process that continues longitudinally as the friction-restrained volumes overlap progressively. This description, however, appears to be marred by the absence of evidence that, for flat tools, expansion in diameter of holes in the central region can occur with square-sectioned blocks as used in the first experiments described. It also neglects the effects, if any, of entrapped gases and the influences that the time taken for and the degree of upsetting might have on the removal of such gases by surface reaction or diffusion. Finally, it is unsupported by experiments which are immediately suggested by their conclusions, namely, to ascertain the effects of lubricating the forging tool surfaces. Such tests, surely easy to perform, would have given considerable weight to their arguments.

Reference

- 1 A. Tomlinson and J. D. Stringer; *J. Iron Steel Inst.*, 1958, **188** (3), 209.

INSTALLATION AT PHOSPHOR BRONZE CO. LTD. UTILIZES THE KOLENE PROCESS

White Metalling Bearings

CAST iron is notoriously a "greasy" metal in the experience of those who have had to prepare it for tinning. The explanation is equally well known: namely, the presence of uncombined carbon in the form of graphite dispersed throughout the crystalline structure of the ferrite base.

The obstacles against providing a chemically clean and continuous surface for tinning are ingeniously overcome by the Kolene process. In this, the workpiece is immersed in a series of baths of which the first contains Kolene 4, a salt of patented formulation. At the temperature maintained in the bath, Kolene 4 has a viscosity lower than water. The workpiece and the heated bath are given opposite charges from a source of direct current, and at first the work is negatively charged to produce reducing members in the bath. Sand is dissolved from castings; scale, rust and other oxides are removed. The low-viscosity molten salt penetrates every microscopic crevice.

After the necessary period of reduction treatment has elapsed—the timing sequence obviously varies with the nature, intricacy and size of the workpiece—the polarity of the workpiece and of the bath are reversed, to promote oxidation. This oxidation removes graphite, grease, and other organic matter, the graphite removal extending far below the surface. The random distribution of the graphite, and the penetration at several angles from the perpendicular, has exceptional significance in the metalling process that is to follow the cleaning process, in that the tinning metal flows into and fills the cavities left by the oxidation of graphite from the surface, and provides the perfect "key" for the white metal above.



VARIABLE DISSIPATION
OF HEAT (GROOVED)

Diagram showing, above, variable section of keyed bearing, and, below, even section of Kolene treated bearing



FAST, EVEN DISSIPATION
OF HEAT (NO GROOVES)

After the oxidation phase, however, the Kolene process is not yet complete, in that a further period of reduction is necessary to convert oxidation products. Thorough rinsing then follows, to remove all traces of the salt. The work is accordingly

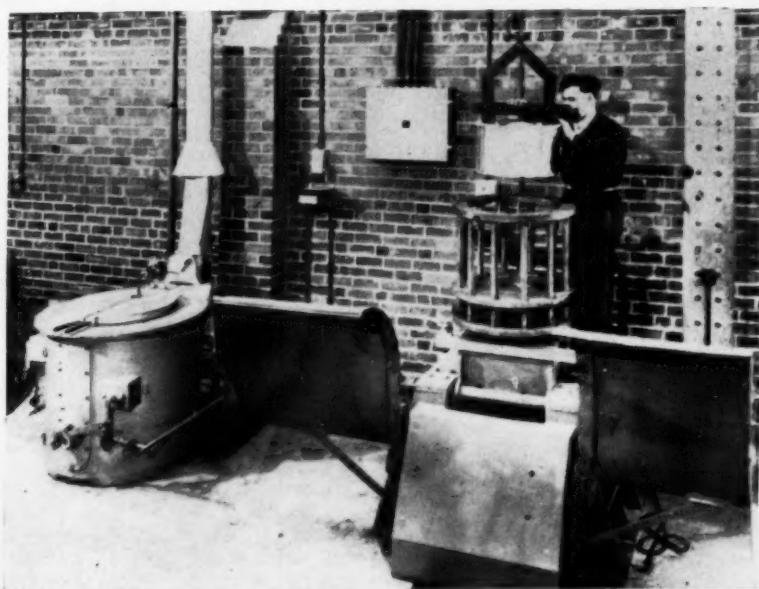
removed from the salt bath after the second reduction treatment, and placed in a succession of baths from which it finally emerges dry and chemically clean, ready for metalling.

Preparation of the bearing halves has been given prominence in this



General view of Kolene plant, showing tin bath extreme right. White-metal furnaces and centrifugal lining machines on left hand side

Tinned bearing being lowered into bearing holder of centrifugal lining machines, for this operation the bearing holder is in a vertical position. Thermostatically controlled white metal melting furnaces on left



article because, it is believed, the Kolene 4 process is a method of producing completely clean cast iron surfaces with a guarantee of 100 per cent reliability. In fact, The Phosphor Bronze Co. Ltd., who have recently laid down new plant for this process, are so confident of the keying effect in cast iron that they have abolished the machining of reverse-taper keys into the metallised faces of C.I. bearing halves. On the contrary, they now advocate plain, unrelieved surfaces, because the provision of relatively

thick, wedge-shaped sections of white metal in a keyed bearing leads to inefficient and unequal dissipation of heat. Thin lining sections, given the new, more intimate junction with the cast iron base, produce faster conduction and dissipation of the heat, without the steep heat gradients that occur in the locally thickened linings.

At the new bearing metallising installation, bearing halves up to 20 in. O.D. will have the white metal run into them under centrifugal action, to produce dense and even linings. Water

cooling, applied during the metallising process, will increase the density even further. Larger bearings will be gravity poured as in the past, using special techniques.

The new metallising shop is equipped to handle bearings up to 6 tons in weight, and the company is able to offer bearings of greatly enhanced performance for steel rolling mills, large diesel engines, heavy electrical equipment, and for other applications where working conditions demand peak performance and maximum reliability.

HIGH VACUUM PROCESS FOR REMOVAL OF IMPURITIES

Electron Beam Melting

A PROCESS for melting and casting special metals, such as titanium, zirconium, tantalum, molybdenum and niobium, which has been proved on a semi-works scale and uses electron bombardment in a high vacuum, has been developed jointly by Stauffer Chemical Company, Mallory-Sharon Metals Corporation and Temescal Metallurgical Corporation. New techniques make possible volatilization and removal of certain critical impurities, resulting in final products of high purity with properties not attainable by other methods. The semi-works plant has successfully melted, purified and cast a dozen special metals in water-cooled crucibles with no contamination from the crucible.

The immediate significance of the process is two-fold:

(1) Electron beam melting should stimulate development of the uses of these newer metals, because the process will make available for the first time commercial quantities of high purity material at substantially lower costs.

(2) In many cases it will permit recycling scrap, thus reducing loss, an important factor in view of the relatively high cost of many of these materials.

The process is based primarily on high vacuum techniques. Heat for melting is supplied by an electron gun which serves as the cathode and bombards the melt stock (the anode) with electrons, heating it to the melting point. Molten metal drops into a water-cooled copper crucible below, in which the heat required to maintain a molten pool is also provided by electron bombardment. The molten pool surface is kept at a constant level as the solidified ingot is withdrawn downward.

Electron beam melting should offer several important advantages over vacuum arc melting. For example, electron beam operations can be stopped and started at any time, whereas arc melting cannot. In the latter process, a valuable ingot is often

lost if it becomes necessary to halt the process. Moreover, the electron beam process can melt material in any form, e.g. ingot, powder, flake or sponge, while the arc process requires compacted material.

The process differs in principle from vacuum arc melting, not only in the heating mechanism (high-voltage electron bombardment rather than a low-voltage electric arc) but also in the level of vacuum used, which is in the range of 0.01 to 0.1 microns rather than 10 to 100 microns. Under the conditions existing in the furnace, carbon, hydrogen and oxygen are generally removed rapidly as carbon monoxide, metal oxides, or similar compounds. As a rule, impurities which form compounds having a vapour pressure of at least 10^{-5} atmospheres at the surface of the melt can be removed easily.

The process also can be used for zone refining. One big advantage cited for electron beam melting is that there is no apparent limitation on the diameter of the bar or ingot that can be processed, as is the case for highly

reactive metals in conventional zone refining operations. As a result, electron-beam-melted materials can be purified faster and cheaper because a larger quantity of metal can be turned out in a given time.

The economics of electron bombardment melting look favourable at the present stage of development because high voltage D.C. electrons are relatively cheap and power efficiencies are high. The purification of niobium requires about 3 to 4 kWh/lb. The power requirement for tantalum is about 6 to 8 kWh/lb. By comparison, the solid state sintering of tantalum uses 500 kWh/lb.

It is claimed that tantalum, molybdenum, and other metals have been produced of higher purity than ever known before. Ductile niobium, previously only a laboratory curiosity made by solid state sintering, is now a commercial reality. One industrial customer has made 0.5 mil niobium foil from a 3 in. ingot by cold rolling without annealing. This was impossible until electron bombardment melting produced a high purity ingot.

High Speed Spectroscopy

DESIGNED for high-speed infra-red spectroscopy, including the analysis of gases, a new type of photoconductive cell has been introduced by Mullard Ltd., Mullard House, Torrington Place, London, W.C.1. The cell (type ORP10) has an uncooled indium antimonide element and is sensitive to infra-red radiations of wavelengths up to 8 microns.

The spectral range covered by the ORP10 is of particular importance to chemists for analytical work, both in the laboratory and for process control during production. Of the 37 chemical groups with fundamental absorption spectra in the infra-red, no fewer than 34 can be studied with the cell.

It will, therefore, have applications in a large number of industries. The main atmospheric absorption bands also fall within its range, and this

suggests its use in photoelectric hygrometry. The study of explosions, shock effects and similar phenomena is a further application, and one in which the cell's very fast response would be particularly significant.

Another use will be in radiation pyrometers, for measuring the temperature of bodies from a distance. Lead sulphide cells are commonly used in this type of equipment for temperatures down to 150°C. Preliminary investigations show that the indium antimonide cell will record within a few degrees of room temperature.

The properties of the cell also suggest that it could replace with advantage the thermal chamber used in some furnaces to determine combustion efficiency by measurement of the carbon dioxide content of the exhaust fumes.

Peaceful Uses of the Atom

BRITISH EXHIBITS AT GENEVA

BRITAIN'S latest work on controlled thermonuclear reactions, the process by which it may in the future be possible to use water as fuel, is to be demonstrated in Geneva next month when the Second International Conference on the Peaceful Uses of Atomic Energy is to be held. This work will be one of the main themes of the scientific exhibition which is being held concurrently with the conference in the grounds of the Palais des Nations. Not only will there be large-scale models of "Zeta" and "Sceptre," but there will be an actual working model of apparatus now in use at the Atomic Weapons Research Establishment.

In this exhibition, one of two taking place in Geneva at the same time, the United Kingdom Atomic Energy Authority has taken 5,000 ft² of space, and in addition to the fusion work there will be sections demonstrating the reactor research programme, some aspects of power research, the technology associated with nuclear development, including surveying for raw materials, research into fuel elements, instrumentation for various purposes, reactor chemistry, chemical processes, and fission product disposal.

The commercial exhibition, being held concurrently, will be in the Palais des Expositions, and the U.K.A.E.A. is providing an exhibit here which includes the practical aspects of nuclear reactors, while instruments and materials available for sale are supported in the Authority's stand by an emphasis on the fuel element service which can support the export of reactors, together with the developments in isotope production and sales service.

More than twenty-six member firms of the Scientific Instrument Manufacturers' Association of Great Britain are showing the most striking developments in their field in the "Grand Palais." Such productions as pulse generators, electrometers, nuclear power plant control, counting and timing apparatus, analysers, spectrophotometers, and many other instrumentation units will be on view.

Among other British organizations participating in this exhibition are the following:—

A.P.V. Company Ltd. An interesting exhibit will be provided by this company on Stand No. 144, showing the work of their fabrication division in aluminium and stainless steel, and also their foundry associated company, A.P.V.-Paramount Ltd., showing castings in stainless and special alloy steels. The former company has fabricated the aluminium core tanks for most of the British research reactors, and some for overseas, and examples of tanks which they have made for Dido, Merlin

and Neptune type reactors will be illustrated, together with a display of weld samples and techniques.

A.P.V.-Paramount will show one of the reactor guide pan steel castings supplied to The General Electric Company Ltd. and Simon Carves Ltd. for the Hunterston nuclear power station, and also lanterns and plug castings in stainless steel for the Bradwell nuclear power station. In addition, castings are shown in a series of corrosion- and heat-resisting materials for other nuclear energy projects.

Ekco Electronics Ltd. A Type N582 nucleonic gauge will be demonstrated on Stand No. 4 F in a specially constructed display unit to illustrate individual control of "screw-down" at each side of a rolling mill, utilizing automatic programmed scanning of the material being produced. Employing transistors and printed-circuit technique, Type N563 gamma backscatter gauge, a self-contained portable equipment for measuring the thickness of pipe walls or sheet materials to which access is possible on one side only, will also be on view. The measuring head is contained in a convenient pistol-grip unit and provides two ranges of measurement, 0 to 0.25 in. (0 to 6 mm.) and 0.2 to 0.75 in. (5 mm. to 19 mm.).

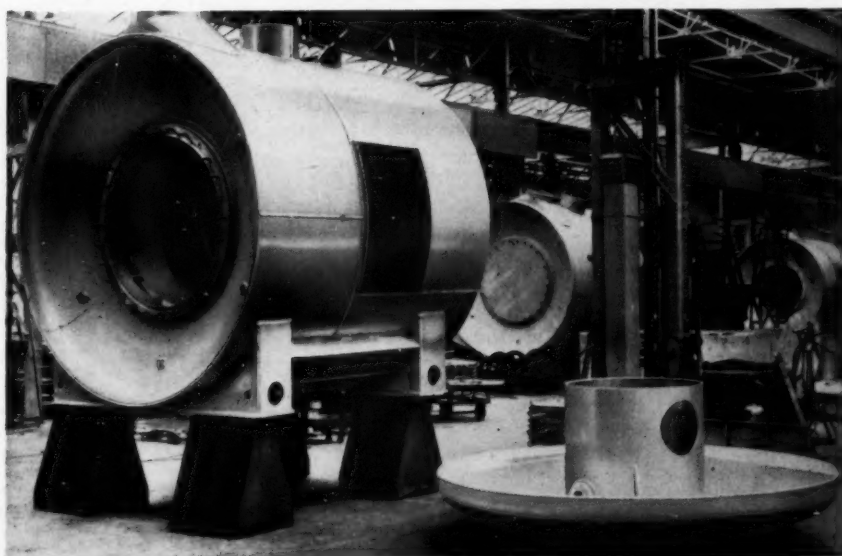
Elliott Brothers (London) Ltd. are occupying Stand No. 113, on which they will display nuclear power plant control instrumentation, a reactor simulator in the form of a reactor control desk and a 54-point scanning recorder which enables voltages from 54 different sources to be recorded on a single chart.

E.M.I. Electronics Ltd. Among the latest electronic equipment on Stand No. 105, being shown for the first time on the Continent, is a new hand and clothing monitor designed to safeguard those engaged in work which may expose them to hazards of atomic radiation.

The instrument detects both alpha and beta contamination on the hands simultaneously, thus enabling the hand count to be reduced to 5 sec.

Also being shown on this stand will be a selection of the most advanced electronic instruments and test equipment, including the WM7 general-purpose wide band oscilloscope. This oscilloscope has been specially developed to meet the specifications of the North American and other world markets, and is capable of satisfying a wide range of specialized needs.

Engelhard Industries Ltd., Baker Platinum Division. Another striking exhibit will be provided by these companies, and among the items to be displayed are the following:—catalytic recombination units—O₂+D₂ and O₂+H₂; heavy water exchange



Light alloy compressor unit housings in course of fabrication, one of the exhibits being shown at Geneva by Marston Excelsior Limited

catalysts; gas purification equipment; oxygen and hydrogen measuring equipment; dissolved oxygen recorders; high temperature precious metal thermocouples; platinum crucibles and laboratory ware; special electrical contacts; palladium diffusion tubes; specially fabricated items using platinum, palladium, rhodium, iridium, osmium, ruthenium, gold, silver, and their alloys.

In addition, there will be shown fuel elements, uranium scrap refining facilities, and rare earth control rods which, however, the company states they are not yet in a position to produce in this country. (Stand No. 27D, in the American section.)

The General Electric Co. Ltd. Visitors to this company's stand (No. 124S) will be able to walk inside a full-size model of a section of a nuclear reactor. Entering the model through one of the gas-outlet ducts, they will be able to examine the intricate constructional detail that lies at the very heart of a nuclear power station. The model is of a gas-cooled graphite-moderated reactor, of similar design to the two which will power the 320 megawatt nuclear power station now under construction by G.E.C. and Simon-Carves at Hunterston, near Glasgow, for the South of Scotland Electricity Board. Other important items displayed on this stand will be a graphite which is completely impermeable to gases and highly resistant to gaseous corrosion; an illuminated schematic diagram will show the layout of a high-temperature gas-cooled zero-energy critical assembly which is being built for the U.K.A.E.A. at its research establishment at Winfrith Heath; and an animated diagram will be displayed to demonstrate the elaborate monitoring system incorporated in nuclear reactor designs, for the rapid detection of faults developing in fuel element cans.

Imperial Chemical Industries Ltd. Both the Metals Division at Birmingham and Marston Excelsior Ltd., of Wolverhampton, will indicate on the stand (No. 140) of this organization some of the extensive contributions which I.C.I. has made to the development of atomic energy, with emphasis on the wide range of metallurgical products which it manufactures for the nuclear engineering industry. A particularly vital contribution made by the company's Metals Division was the development and production of porous barriers for use as diffusion membranes in the uranium isotope plant. These membranes are built into plant components by Marston Excelsior Ltd., a subsidiary company.

Under subject headings, the I.C.I. display is divided quite simply as follows:—"New" metals, e.g. beryllium, vanadium, and niobium; titanium and zirconium; fuel cans; "Integron" heat exchanger tubing; and fabricated components. Simple products made in these various metals will be exhibited, and a display of wrought titanium and zirconium products will include an ingot of I.C.I. titanium, made in the company's vacuum melting plant and weighing nearly two tons. There will also be a display of fuel cans, typical examples of "Integron" finned tubing, and various fabricated components in aluminium and its alloys, stainless steel, titanium, and zirconium.

The Mond Nickel Company Ltd. The properties of nickel-containing materials have contributed in no small measure to the successful development of many new industrial and scientific processes, and the corrosion and heat-resisting characteristics of nickel alloys have a particularly important role to play in nuclear engineering. The Mond Nickel Company and its associate, Henry Wiggin and Company Ltd., provide on their stand (No. 138) an example of the world-wide service of technical information about nickel-containing materials and the role of nickel in the field of nuclear engineering. Some 60 different technical publications—many of them in French, German or Italian—will support information panels dealing with the subjects of corrosion resistance, strength at high temperatures, welding, controlled thermal expansion, and the cobalt-free characteristics of Mond nickel pellets.

Mullard Ltd. The range of Mullard halogen-quenched Geiger-Muller tubes to be shown on Stand No. 111 includes two new types—the MX133 and MX143.

The MX133 is for the detection and measurement of beta particles and gamma radiation. The tube has a sensitive area of 36 cm², and is designed for applications requiring a greater sensitive area than is normally provided by end-window types. Its uses include the monitoring of laboratories and, in conjunction with a holder and absorbers, the assay of crushed radioactive ores. Because of its glass construction, it is also suitable for dipping into liquids.

The MX143 is an all-metal gamma tube for use where high sensitivity and robustness are required. The chrome iron cathode forms the main body of the tube, and the glass required for insulation has been kept to the minimum. The diameter is

constant over the length of the tube; this allows a number of tubes to be mounted close together in multiple arrays for higher sensitivity to wide beams, without the wastage of space which occurs when glass wall tubes are used. This feature is particularly important in applications such as cosmic radiation measurements, and in anti-coincidence screens for low background counting.

Both tubes are low voltage types, and will operate at temperatures over the range -55° to $+75^{\circ}$ C. They have a minimum count life of 5×10^{10} and possess the feature, common to all Mullard halogen-quenched tubes, of rigidly standardized working voltages, so that any tubes of a type taken at random, or even supplied over a period of time, will all satisfy identical conditions.

Nuclear Graphite Ltd. A section of the A.E.I.-John Thomson Nuclear Energy Co. Ltd. stand (No. 103) will be devoted to a display illustrating the part which Nuclear Graphite Ltd. plays in the consortium. This company is specializing in machining graphite components for nuclear reactors. Specially designed plant has been installed enabling them to machine large tonnages of very pure graphite to extremely fine tolerances.

The display will show graphite bricks and tiles similar to those to be used in the Berkeley Reactor. Also on show will be a wide variety of graphite engineering components, indicating the skill and versatility of the various machining processes.

W. G. Pye and Co. Ltd. Details of the new Argon Chromatograph, which has a sensitivity 100,000 times greater than the conventional models, will be available on Stand No. 112, where the following will also be on show.

A new portable Wheatstone bridge, specially designed to combine compactibility and precision; it is self-contained, with built-in galvanometer and batteries. The Pye 6001 precision instrument switches, with their low contact resistance and long life without maintenance, are fitted. A new presentation gives a reading in line against a contrasting background. External galvanometers and batteries can also be fitted.

A thermocouple test set combining three instruments in one. Fully portable, it contains a potentiometer, Wheatstone bridge and potential source, all of which may be used separately if required. All the facilities for testing thermocouples and their associated indicators, controllers and recorders are provided.

Shell Petroleum Co. Ltd. The exhibits on Stand No. 139 deal with research into radiation-resistant lubricants, with an animated model of the cobalt 60 source at Shell's research centre, and will also include a model of the Bradwell power station.

T.I. Nuclear Engineering Ltd. This company will be including in its exhibits on Stand No. 142, tubes in special metals, such as niobium, vanadium, zirconium, tantalum, titanium and beryllium. Also fuel element cans in aluminium and magnesium, and finned heat exchanger tubes.

An associated company, Talbot Stead Tube Co. Ltd., will show such items as—pressure vessel, breeder thermocouple guide tubes, fuel element support, restraint bar, charge plug, stainless steel tubes and flanges. In addition, there will be on view the following scale models:—(1) control rod, fabricated from stainless steel, with boron inserts; (2) restraint bar, fabricated from mild steel, outer tube with four other tubes inserted, centre bar inserted in the smallest tube; and (3) charging stand-pipe assembly—fabricated from mild steel; upper portion consists of outer tube concrete-filled with four tubes inserted; lower portion consists of large tube with smaller tube fixed on outer wall.

Unicam Instruments Ltd. This firm exhibits on Stand No. 112 a range of spectrophotometers which can be used for the analysis of radioactive materials under remote control.

The Unicam SP.500 ultraviolet and visible spectrophotometer provides the facilities for absorption measurements at all wavelengths from 1,600 Å to 10,000 Å, and combines simplicity of operation with performance factors of a high order. There is a new fused silica prism, introduced in July, 1958, which enables the instrument to be used down to a wavelength of 1,860 Å and permits outstanding resolution in the important 190-220 μ region.

A high-temperature powder camera (Unicam SP.150), designed for powder and fibre specimens, and for small block specimens which may be oscillated for glancing angle and back reflection photographs, will also be on view. The furnace is designed to give a long life performance at temperatures up to 1,400°C., including long periods at such temperatures. The instrument is water-cooled and evacuable to 1×10^{-5} mm. Hg or better.

Industrial News

Home and Overseas

Exhibiting at Farnborough

Following our notes under this heading last week, when we were able to give details of some of the exhibits to be seen next week at the S.B.A.C. Flying Display and Exhibition at Farnborough, we have now received details of some of the exhibits which will be made on Stands 130-1-2 by the **British Oxygen Group**. A wide range of their activities in the field of aeronautical engineering will be covered by the three companies in the group.

Airfield and rocket site equipment will be featured, and British Oxygen Aero Equipment Ltd. will show, by means of models, photographs and actual exhibits, some of the breathing equipment which is fitted in military and civil aircraft. The development of welding and cutting in the aircraft industry will be illustrated in the exhibits of British Oxygen Gases Ltd. Automatic Argonarc welding, also spot welding, will be featured, as well as oxy-acetylene welding and cutting equipment.

Other firms providing interesting exhibits at Farnborough are the following: **Birmetals Ltd.**, **Birmingham Aluminium Casting (1903) Ltd.**, **James Booth Ltd.**, **British Aluminium Company Ltd.**, **David Brown Industries Ltd.**, **Desoutter Brothers Ltd.**, **Elliott Bros. (London) Ltd.**, **English Electric Co. Ltd.**, **Fawcett, Preston and Co. Ltd.**, **Firth-Vickers Stainless Steels Ltd.**, **General Electric Co. Ltd.**, **High Duty Alloys Ltd.**, **William Jessop and Sons Ltd.**, **Kelvin and Hughes (Aviation) Ltd.**, **Kent Alloys Ltd.**, **Magnesium Elektron Ltd.**, **The Mond Nickel Co. Ltd.**, **Murex Welding Processes Ltd.**, **The Phosphor Bronze Co. Ltd.**, **Reynolds T.I. Aluminium Ltd.**, **Sheffield Smelting Co. Ltd.**, **Shell-Mex and B.P. Ltd.**, **J. Stone and Co. (Charlton) Ltd.**, **Tiltman Langley Ltd.**, **The Tungum Co. Ltd.**, and **Henry Wiggin and Co. Ltd.**

Behaviour of Metals

It has become the custom to publish in book form each year the Papers read at the Refresher Courses held by the Institution of Metallurgists for its members. Just published, under the title of "Effect of Surface on the Behaviour of Metals," are the Papers read during the 1957 course held by the Institution. As its title implies, the present volume deals with the important part which surface plays in influencing the behaviour of metals. It contains a great deal of information, collected from widely scattered sources, about a subject that is still far from being completely understood, but a knowledge of which is becoming increasingly important to physicists, chemists and engineers, as well as to metallurgists.

The book is published for the institution by **Iliffe and Sons Ltd.**, Dorset House, Stamford Street, London, S.E.1. It covers 100 pages, including 30 diagrams in the text and 10 pages of art plates. The price is 21s. net (postage 10d.).

Good Faith Warrant

Active steps are being taken by the members of the Hollow-ware division of the **Vitreous Enamel Development Council** to correctly inform the trade and the consumer on the virtues, hygienic and economic, of vitreous enamelware. Com-

mencing as from now, a vigorous promotion campaign is based on a warrant of quality which will be applied to the hollow-ware manufactured by the members of the Council. This warrant will guarantee fine finish, and replacement of the article within twelve months should there be a manufacturing fault.

The announcement of this warrant underlines the fact that the Council is fully aware that not enough has been said to date about the realistic advantages and values of vitreous enamel products. A promotion campaign, which includes both planned advertising and public relations programmes, will be launched to the public in October next (in September to the trade).

Foundry Machines for Russia

A pair of Coleman-Wallwork automatic moulders have recently been completed by **The Coleman-Wallwork Co.** for shipment to Russia.

These machines, complete with drag mould turnover and transfer unit, are designed for fully automatic mould production at the rate of 300 half-moulds/hr. The empty box (or flask) enters on a conveyor at the right-hand side and passes through the machine to receive a weighed quantity of sand. Next, the mould is rammed, the pattern stripped, inverted and deposited on a second moving conveyor (left-hand side). The sequence of operations is fully automatic and this machine will produce half-moulds up to a maximum size of 36 in \times 24 in \times 15 in. One of these machines is illustrated below.

Selling to China

It is reported by **Quasi-Arc Limited**, of Bilston, that they have increased their sales of electrodes in China by adopting a new Dragon symbol. The difficulty of putting over the name "Quasi-Arc" in Chinese is one which has occupied the attention of the firm's associate company in China, **British Oxygen (Hong Kong) Ltd.**, for some time. Initially, a name

was devised which presented the phonetic sound "Quasi-Arc" and which had an appropriate meaning in Chinese. It was discovered, however, that as a result of the large number of dialects which are spoken throughout the country, the new name did not stimulate sales to any great extent. In view of this, it was abandoned.

Recently, however, the associate company decided to adopt a symbol instead of the name, for the marketing of the electrodes. Their new trade mark is in the form of a Red Dragon, and is not only easily recognized but also easily described. Early reaction from customers was said to be very favourable, and a large number of these, no longer confused by the firm's name, are now asking for "Red Dragon electrodes."

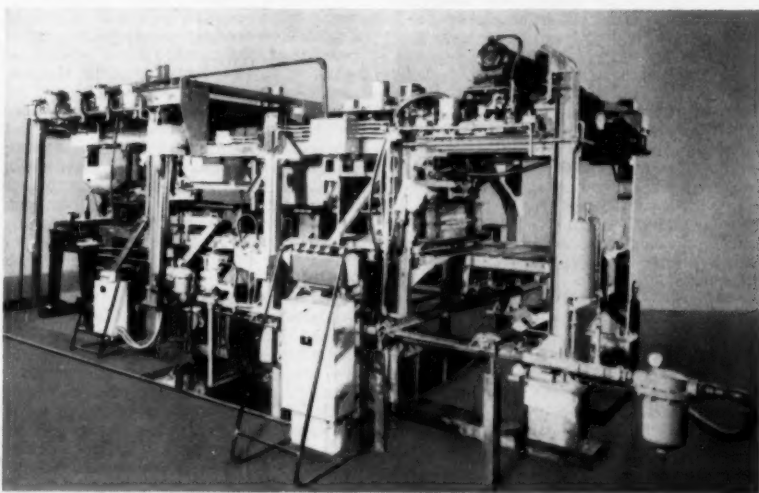
Protecting Goods for Export

Research into the problems of packing and storage is being carried out in a laboratory designed solely for this purpose at the **Salterpak Division of Geo. Salter and Co. Ltd.** Here, modern scientific instruments reproduce every kind of hazard to which a package may be subjected, providing facts from which the most suitable and economical packaging for any type of product or goods can be devised. Before the advent of pack testing, the tendency was to increase the size and strength of all packing materials where breakages were due to faulty packing. The efficiency of a pack, however, depends not necessarily upon sheer strength, but upon correct design and construction so that goods, particularly those for export, will survive extreme climatic conditions and transport risks.

Enquiries from U.S.A.

Enquiries have been sent to the Board of Trade from the British Consulates at Houston, Texas, and Los Angeles. The former is from **Nicholas and Parks Machinery Company**, of 2800 Commerce Street, Dallas, Texas, who are interested in obtaining from the United Kingdom a rolling mill for rolling aluminium strip continuously, width up to 12 in., thickness

One of the Coleman-Wallwork automatic mould-making machines completed for a Russian order



from 0.015 in. up to 0.080 in., the mill to be electrically driven, 3-phase, 220 volts A.C., 60 cycles.

The second enquiry is from Mr. Arthur M. Andersen, of the Empire Steel Buildings Company, 2137 North Marianna Avenue, Los Angeles 23, who will be in London, at Grosvenor House, from September 21 until September 25, when he will move on to Edinburgh. Mr. Andersen is hoping to buy metal-working machinery, guillotines, drilling machines, and other types.

British manufacturers interested in either of these enquiries are invited to contact the enquiring firms direct.

Mechanical Engineering Research

Greater efforts to recover money from industry for services rendered by the Mechanical Engineering Research Laboratory at East Kilbride is one of the recommendations made by a House of Commons Select Committee on Estimates in a report on the Department of Scientific and Industrial Research.

The East Kilbride establishment's estimated expenditure for 1958-59 is given at £618,787, but it is also estimated that only 5.9 per cent of this figure will be recovered from industry.

The engineering industry was well aware of what was being done at the laboratory. When it was open to the public last year there were about 1,500 visitors, not only from the Scottish engineering area but from England as well.

News from Birmingham

Quiet conditions continue in the metal-using industries in the Midland area. Labour disputes have recurred in the motor trade and are again causing serious difficulty to manufacturers. Shipments against export contracts are being delayed. In spite of that, the motor trade continues the brightest spot in the industrial picture. The outlook for the brass and copper trade is more optimistic now that prices are hardening, but at present most firms are operating below capacity. Makers of water fittings have lost business because of the decline in the building industry, and particularly the reduction of activity in housing programmes sponsored by local authorities.

Further recession has taken place in the iron and steel trade. Demand for sheet and strip is maintained, but otherwise conditions are dull, and more works have been put on short time. Imports of both semi-finished and finished steel have dropped sharply over the last few months. Re-rollers need smaller supplies of billets pending an improvement in the demand for finished products, and the necessity for importing heavy steel plates has disappeared now that reasonably early delivery can be given from the home mills. Despite cancellation of contracts, some of the shipyards are still very well situated for work, and this is reflected in the sustained demand for forgings and castings used in marine engineering which reach Midland works.

Cantata for Metal Union

When the West German Metal Workers' Union, *Industriegewerkschaft Metall*, holds its annual conference in Nuremberg, from September 15-20 this year, proceedings will open with the first performance of a new cantata entitled simply "Metal."

Composed by Hans-Ulrich Engelmann, and with a text by Heinz Sabais, the cantata takes as its theme the extraction

and working of metals through the ages, starting from prehistoric days and developing through the machine age into the atom age.

Business Expansion

Expansion of business in the field of light alloy die-casting, aluminium bronze and bronze founding has led Ariston Alloys Ltd., of Mill Lane, Croydon, to acquire an additional factory to enable them to cope with increased production. The new factory is situated in Stafford Road, Croydon.

Quality Control Conference

A three-day international conference is being organized by the European Organisation for Quality Control at Essen from September 10-12 on the subject of "Consumer-Vendor Relations." This conference, the second of its kind to be arranged, will deal with product quality, sampling inspection, statistical methods, and the general engineering, practical and theoretical aspects involved in the subject.

Application forms and further particulars about the conference can be obtained from the British Productivity Council, 21 Tothill Street, London, S.W.1.

Change of Name

At an extraordinary general meeting of Hall Engineering Industries Limited, held on Thursday, August 21, in London, a resolution to change the name of the company to Hall Engineering (Holdings) Limited was approved.

Copper Wire for Sudan

Tenders are being called for by the Ministry of Communications in the Sudan for the supply of 10 tons cadmium wire, 40 lb. per mile, to B.P.O. specification 175/1951, and 50 tons hard drawn copper wire, 100 lb., to British Standard Specification No. 174/1951.

Tender forms and specifications may be obtained from the Controller of Stores and Workshops, Post and Telegraph Departments, Light Industrial Area, Khartoum South, and the closing date for the receipt of tenders is 1200 hours on October 7 next.

The British Board of Trade, in their announcement of this enquiry, stress the fact that ability to give early delivery will influence the selection of tenders.

Instrument Training School

A training school to instruct customers' operators and maintenance staff in the use of Sunvic pneumatic and electronic control instruments has recently been opened by Sunvic Controls Ltd. at their Harlow, Essex factory.

Duration and content of the course are flexible, depending upon the degree of technical detail required by students, but it will not generally exceed one week. It will cover design, operation and applications of the pneumatic range of process control instruments, which are widely used in the oil and chemical industries.

Scientific Films

Owing to the continued growth in membership, and the consequent increased demands on its services, the Scientific Film Association has moved to new offices in 3 Belgrave Square, S.W.1. These premises have been made available by A.S.L.I.B., and it is anticipated that this closer relationship will introduce the work of the Scientific Film Association to many who are concerned with documented information of all kinds.

The Association also announces first details of its forthcoming 1958-59 programme of meetings. These include: "Scientific Films in the Soviet Union," October 29; "Presenting Science and Technology to Specialist and Layman—the Contribution of Film," December 9; "Films in the Service of Science," January 21, 1959; "Films in the Service of Industry—Some Observations by Industrial Film Users," February 18, 1959; "Recent Developments in Research Film—a Symposium," March 18, 1959; "Scientific and Documentary Films from Czechoslovakia," April 15, 1959.

International Film Congress

Among the films to be presented by the British delegates at the XII Congress of the International Scientific Film Association, to be held in Moscow from September 10-20, 1958, are the following: "Forming of Metals" (Shell Petroleum Co. Ltd.); "Conquest of the Atom" (Mullard and E.F.V.A.); "The Electron Microscope in Solid State Physics" (Cavendish Laboratory, Cambridge); "Material Transfer in Aluminium Self-Adjusting Welding Arcs" (British Electrical and Allied Industries Research Association).

Aluminium Portals and Purlins

For the canteen at a new factory for the Ardath Tobacco Company, a light but rigid and durable portal frame assembly with an attractive appearance was required. Noral B51SWP alloy sheet and sections, supplied by Northern Aluminium Company Limited, were employed in the portal frames and purlins.

There are eight closed rectangular box-section portal frames, each of which consists of two upright legs splayed in at 6° to the vertical, and integral with an arched upper member. Each portal frame is 12 ft. high and has a span of 21 ft.

The concrete clerestory roof is supported by steel reinforcements enclosed in aluminium box brackets, which have an aperture to allow the pouring of grout. Tee-section brackets riveted to the top portal flanges support the top of the clerestory.

The purlins are 5 in. by 2½ in. extruded bulbed and lipped channels, and are secured to the portals by bolted-on angle brackets. They support a "Stramit" roof lined with felt.

The building was fabricated and erected by Aluminium Alloy Fabrications Limited, of Woking.

Birlec in South Africa

Consolidating their venture into the South African market, made early in 1956, Birlec Limited announce that a Johannesburg branch office, under the management of Mr. S. G. King, has now been formed. Situated between Boksburg and Benoni, the new branch will deal with all enquiries, including project design and engineering service work. The postal address is P.O. Box 99, Witfield, Transvaal.

In November, 1955, Mr. King, formerly manager of Birlec's London office, established an office in Johannesburg. There, he acted in an advisory capacity to the B.T.H. Company (S.A.) Pty. Limited, who, for the interim period, were agents on behalf of Birlec.

In the Federation of Rhodesia and Nyasaland, the British Thomson-Houston Company (Central Africa) (Pvt.) Limited will continue to act as Birlec agents, but

the services of the new branch will now be fully available to Birlec furnace users in the Federation, particularly for technical advice and assistance when required.

Change of Address

The executive offices of **Kelvin and Hughes Limited** have been transferred from 2 Caxton Street, London, S.W.1, telephone Abbey 7333, telegrams Kelhue, Sowest, to new premises at Empire Way, Wembley, Middlesex; telephone Wembley 8888; telegrams Kelhue, Wembley.

Furnace Equipment

An order has been received by **Wild-Barfield Electric Furnaces Ltd.** from the Leeds locomotive building firm, the Hunslet Engine Co. Ltd., for a large gas carburizing furnace, 48 in. diameter by 54 in. deep, operating on the "Carbodrip" drip feed system.

The equipment, rated at 150 kW, will gas carburize a range of components varying from hackshaft wheels 3 ft. 7 in. in diameter to shafts 4 ft. 6 in. long.

An order for two 100 lb. arc melting vacuum furnaces of the cold mould type has also been received from the Atomic Energy Authority, Risley. Basically, the equipments follow the design of NRC model 2721, but adaptations are being made to meet the requirements of the customer in relation to ingot size.

The furnaces will be used for consumable and non-consumable melting. Each equipment has its own pumping system, but a common power supply is arranged, there being three rectifiers. Output is such that a 4 in. ingot can be melted in each furnace simultaneously with a 50 per cent reserve of power. Alternatively, a 6 in. ingot can be melted in one furnace with a similar power reserve.

U.K. Metal Stocks

Last week-end stocks of refined tin in London Metal Exchange official warehouses totalled 16,788 tons, comprising London 6,127, Liverpool 9,146, and Hull 1,515 tons. Copper stocks totalled 11,942 tons, and comprised London 5,999, Liverpool 5,668, Birmingham 75, Manchester 50, and Swansea 150 tons.

Export Licensing Control

Export control under the Export of Goods (Control) (Amendment No. 3) Order, 1958, coming into operation on September 1, 1958, is imposed on a few goods for export to the Soviet Bloc and China for the first time, but, in the main, the Order removes export control from a wide range of goods. The main changes in the non-ferrous industrial field are:—

(a) That control has been imposed on the following: boron carbide, boron nitride, diethylenetriamine, vibration testing apparatus.

(b) That control has been lifted completely from the following: certain types of aluminium and alloys and powder; carbonyl iron powder; molybdenum carbides; A.P.I. pipes and tubes; certain types of wire rope; vacuum pumps; certain types of wire and strip of copper and copper alloys; apparatus for removing surplus stock from workpieces; water lubricated bearings; diamond tools, dies and abrasives; steel works plant (control being retained on certain types of rolling mills); crystals of lithium or calcium fluoride; temperature sensitive resistors; pH apparatus; spectrographic instruments and apparatus; barium nitrate; titanium carbide; diamond powder.

(c) That amendments have been made to restrict the application of export control to a much narrower range of articles within the following general descriptions: metals and alloys (control of cobalt and germanium has been relaxed to certain destinations); marine boilers, etc.; chemical and petroleum plant and equipment; compressors, blowers and fans; furnaces; machinery for the manufacture of electronic vacuum tubes or valves; metal working machines; machine tool parts and accessories; metal cutting and woodworking tools; measuring and counting apparatus; microscopes; electrical machinery; X-ray apparatus; molybdenum compounds.

(d) In addition, due to the easier supply position, the opportunity is taken to free from control to all destinations the export of certain steel plates.

Copies of the Order, S.I. 1958, No. 1417, price 5d. (7d. by post) are available from H.M. Stationery Office, Kingsway, London, W.C.2.

Mine Products

Appointed as sole distributors in the U.K. for the South African mining group, **Rhine Ruhr (Pty.) Ltd., Law, Wills and Company Limited**, Leadenhall House, 101 Leadenhall Street, London, E.C.3, will thus be in a position to arrange for supplies of fire clay, andalusite, molybdenum ore, raw magnesite, vermiculite, and high-grade kaolin.

Magnetnetting Equipment for China

Magnetic separators for research work are to be supplied by the Birmingham firm, **Rapid Magnetic Machines Ltd.** to an order from China. The order, which is a large one, has been procured in face of severe competition from the United States and Germany, and represents one of several obtained by the firm's managing director, Mr. W. B. Lane, on a recent sales tour.

Yugoslav Copper and Aluminium

Financial interests in France and Belgium are helping the Yugoslav Government to exploit potential copper ore deposits at Majdanpek. The scheme is planned to raise Yugoslav copper production from 30,000 tons to 55,000 tons a year. Explorations have shown that the region has a potential reserve of about 290,000,000 tons of copper ore, about 25 per cent of European reserves.

The present investment, to be repaid by copper sales, is being made by a consortium of French companies, under the name of Compadec, in association with Belgian interests.

The waste gases from the copper smelting plant will be used to produce sulphuric acid, which will go towards the production of 570,000 tons of superphosphates a year in an associated factory.

Meanwhile, preparatory work has been halted on another major Yugoslav industrial development scheme, the building of an aluminium combine at Titograd, Montenegro, originally started with the promise of a 175,000,000 dollar loan from the Soviet Union and East Germany.

The loan—part of 285,000,000 dollars in Soviet credits—was suspended in May. The loan was to have been repaid by the supply of aluminium, but some Yugoslav economists believe the local costs would have imposed a severe burden on the economy.

It is not yet clear whether the Yugoslav Government will eventually seek Western

aid for the aluminium combine, or whether the scheme will go forward in the way originally drafted with the Soviet Union. Under that plan, output was intended to be 100,000 tons of aluminium a year. Only foundation work has been carried out at the site so far.

Alumina for Norway

An agreement between Aluminium Union and A/S Aardal og Sunndal Verk will bring about 4 million metric tons of alumina, mainly from the West Indies, to Norway for processing. Payment is to be made in aluminium. The contract, which covers a large part of the Norwegian firm's alumina requirements up to 1978, is thought to be one of the largest deals handled in Norway.

New Premises

Increased business in special refractories and the wider range covered by the **Midland Monolithic Furnace Lining Co. Ltd.** has necessitated larger premises and sufficient space both for manufacturing and for office accommodation has now been acquired. The production of ganisters, ground clays, etc., will be continued at the quarry, but all administration and sales will be transferred, as from September 1, to the new address, which is Goose Lane, Barwell, Leicester. Tel.: Earl Shilton 2061-2 (2 lines).

Men and Metals

An announcement has been made by the directors of **Birfield Limited** to the effect that **Mr. S. Walker** has retired as managing director of **Laycock Engineering Limited** on reaching the age of 65, but has been appointed vice-chairman of that company. **Mr. W. E. Thompson** and **Mr. K. Walker** have been appointed joint general managers. **Mr. S. Walker** has also been appointed additional director of **Birfield Limited**.

Resigning as from August 31, **Mr. N. S. Billington**, M.Sc., M.I.H.V.E., who has been head of the National College for Heating, Ventilating, Refrigeration and Fan Engineering since February, 1950, is to take up an appointment as Director of the Heating and Ventilating Research Council. As successor to **Mr. Billington**, the Governors of the National College have appointed **Dr. David R. Scott**, at present a senior lecturer on the staff of the Royal College of Science and Technology, Glasgow.

Three new appointments have been made to the board of **British Titan Products Company Ltd.** The new directors are **Mr. N. D. Harris**, **Dr. P. A. Lintern** and **Mr. S. G. Tinsley**.

A recent addition to the board of **Bruce Peebles and Co. Ltd.** is **Mr. T. Coughtrie**.

Forthcoming Meetings

September 4—Institute of Metal Finishing, North-West Branch. Engineers' Club, Albert Square, Manchester. "Effluent Disposal With Regard to the Small User." F. Wild. 7.30 p.m.

Metal Market News

WHATEVER picture may emerge in regard to non-ferrous metal usage in this country during the second half of this year, it is apparent that copper especially, but also lead and zinc, put up a good show in the period January to June. The tin tonnage, to which reference was made in our report last week, declined sharply. The British Bureau of Non-Ferrous Metal Statistics has published the following details (in long tons of 2,240 lb.): copper, refined and scrap, consumption in the first half year was 328,718, against 331,247 in 1957, while the corresponding figures in zinc were 154,141 and 161,623. In lead, the 1958 half year's tonnage was 170,868, compared with 177,156 in the corresponding period last year. June this year was a good month, for copper consumption, including about 11,000 tons of scrap, amounted to 57,418 tons, which was fully 3,000 tons up on the May figure. Stocks declined from 88,913 tons at May 31 to 81,851 tons at June 30. In lead, usage of refined metal plus secondary was a couple of hundred tons down on May at 28,624 tons, while stocks of refined lead were some 6,000 tons up at 40,518 tons. In zinc, the pattern of usage was somewhat similar, for the June tonnage, at 25,587, was 1,000 tons up, but stocks dropped by about 900 tons to 49,613 tons. These are quite good figures and really relatively better than in the United States, where the fall in consumption this year has excited a good deal of comment. As mentioned last week, refined copper deliveries dropped by 23,300 tons in July, and at 77,500 short tons they are back to the low level at which they have been maintained of late.

This poor rate of consumption makes all the more surprising the decision, announced by Kennecott on Thursday last week, to increase their production again from a five-day week to six. It will be remembered that only the other day there was an adjustment from four-day to five-day working, or rather an announcement of intention to do this, and now we have yet another addition to the annual output. The news came through while the afternoon Kerb market was in progress, and the three months' quotation, which had been steady at £207 10s. 0d., dropped in late dealings to £206. In the earlier part of the week there was a good deal of fluctuation owing to the contradictory reports coming through about the prospects for the Minerals Stabilization Bill. It hardly seems as though there has been any rush to buy copper by those countries to which exports have previously been banned, but it is understood that a good many enquiries have been circulating. U.K. consumers

have been buying cautiously, and activity is still restricted by the holiday season.

On Friday, the scene changed with dramatic suddenness on the announcement that the Metals Stabilization Bill had been thrown out by the House of Representatives. As anticipated, the market opened around £201 and stayed down with a turnover of about 1,600 tons. At the close, cash stood at £200 5s. 0d. and three months at £200 10s. 0d. On the afternoon session there was a recovery of £2. The highest point reached during the week was £208 5s. 0d. Warehouse stocks dropped by 115 tons to 12,342 tons. Just what the course of copper prices is going to be now remains to be seen. Cash tin closed without change at £730 10s. 0d., with three months at the same level, this meaning a gain of £2 10s. 0d. on the week. Lead and zinc moved in an erratic fashion but closed above the lowest—£68 for August lead and £62 5s. 0d. for zinc—at £69 5s. 0d. and £63 15s. 0d. Stocks of tin dropped by 487 tons to 17,045 tons. At the end of the week, the St. Joseph Lead Co. announced a cutback in output of about 20 per cent.

New York

The feature of the U.S. non-ferrous metal market last week was the cut of a quarter of a cent per lb. to 10-75 cents in the price of lead. This reduction was prompted by declines in London, which had brought the metal down to the equivalent of some 8-77 cents per lb. on the London Metal Exchange early in the period. Adding two cents to pay freight, insurance and duties on imported lead, this brought the price for such lead to around 10-75 cents New York. Lead producers and custom smelters said that if there was any further weakening in London, a drop of a further quarter-cent would take place in New York.

The domestic lead companies said their sales thus far in August were better than in July, but were still moving at a "sub-normal rate insufficient to move production, which is accumulating." The price cut did not result in a sharp rise in dealings, since traders do not usually buy on falling prices, according to one lead source. The usual immediate reaction is to wait for prices to fall further.

Zinc demand was small during the week under review, with most quarters watching and waiting for developments from Washington.

Tin eased, with consumers buying very sparingly. The action in the domestic market was influenced by the lower tendency in London, attributed to continued selling of Russian tin, which was being absorbed by the Buffer Stock.

In copper, large producers and custom smelters maintained their price at 26-50 cents per lb., with business moderate for both. Meanwhile, copper men reported that their price of 26-50 cents per lb. was "firmly based" and "in line with demand." One big producer said sales were good and things looked better than they had in some months. Another described sales as normal currently with a slight rise in volume anticipated during the coming few weeks as orders flowed in for September delivery. Copper industry officials were undaunted by figures released last week showing that July shipments of copper had dropped to 77,523 tons from June's 110,757 tons. They noted that June shipments were swollen by hedge buying in anticipation of a price rise, and that July is normally a slow month.

At the week-end, traders said that marked pressure on the copper export price had developed because of the defeat of the Seaton Bill and the resultant fall in the London copper price. Scrap copper was half a cent lower. Some sources said further easing in copper may be in the offing, with the custom smelter price perhaps declining about half a cent a lb. next week.

Tin was very steady in early dealings reflecting the advance in Singapore, but later turned barely steady and quiet.

In silver, domestic business amounted to approximately 255,000 oz. The open market price continued at 88½ cents a fine oz.

Rome

In the first five months of the current year, imports into Italy of crude copper for smelting and refining amounted to 1,807 metric tons, worth 571,483,000 lire, of which 501 metric tons was temporarily imported, according to the Italian Statistical Office. The main origins of the imports were Indonesia, with 101 metric tons, and Chile with 1,604 tons.

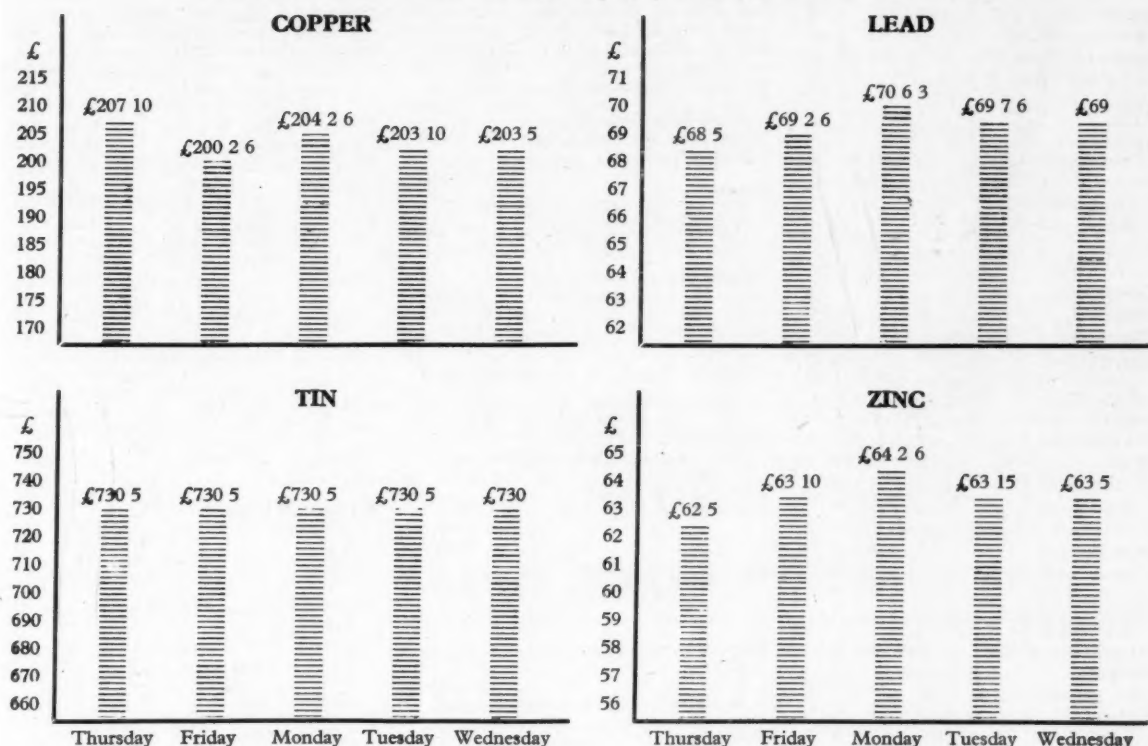
Imports of refined copper in slabs, ingots, granulated and powdered forms were 35,815 metric tons, valued at 10,978,856,000 lire, of which 6,380 tons were imported on a temporary basis. Main origins were Britain, with 3,611 tons, the Belgian Congo, with 5,717, Chile, with 7,060, and the United States, with 10,140 metric tons.

In the first five months of the current year, Italy exported 152-2 metric tons of quicksilver, compared with 681-4 metric tons in the corresponding period a year earlier, according to the Central Statistical Institute.

Main destinations were Czechoslovakia, 17-2 metric tons; France, 24-3; Poland, 51-7; Britain, 17-2, and Brazil, 13-8 metric tons.

METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 21 August 1958 to Wednesday 27 August 1958



OVERSEAS PRICES

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ⇌ £/ton	Canada c/lb ⇌ £/ton	France fr/kg ⇌ £/ton	Italy lire/kg ⇌ £/ton	Switzerland fr/kg ⇌ £/ton	United States c/lb ⇌ £/ton
Aluminium		22.50 185 17 6	210 182 15	375 217 10		26.80 214 10
Antimony 99.0			195 169 12 6	420 243 12 6		29.00 232 0
Cadmium			1,500 1,305 0			155.00 1,240 0
Copper						
Crude						
Wire bars 99.9				415 240 15		
Electrolytic	29.00 212 0	24.75 204 10	260 226 5		2.65 221 10	26.50 212 0
Lead		10.50 86 15	110 95 15	179 103 17 6	.88 73 10	10.75 86 0
Magnesium						
Nickel		70.00 578 5	1,205 1,048 7 6	1,300 754 0	7.50 627 2 6	74.00 592 0
Tin	102.00 745 12 6		890 774 7 6	1,400 812 0	8.60 719 2 6	94.87 759 0
Zinc						
Prime western		10.00 82 12 6				10.00 80 0
High grade 99.95		10.60 87 10 0				
High grade 99.99		11.00 90 5				
Thermic			107.12 93 2 6			
Electrolytic			115.12 100 2 6	159 92 5	.88 73 10	11.25 90 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 12 noon 27/8/58)

PRIMARY METALS

	£	s.	d.
Aluminium Ingots.... ton	180	0	0
Antimony 99.6% "	197	0	0
Antimony Metal 99%.. "	190	0	0
Antimony Oxide..... "	180	0	0
Antimony Sulphide Lump..... "	190	0	0
Antimony Sulphide Black Powder..... "	205	0	0
Arsenic..... "	400	0	0
Bismuth 99.95%..... lb.	16	0	0
Cadmium 99.9%..... "	10	0	0
Calcium..... "	2	0	0
Cerium 99%..... "	16	0	0
Chromium..... "	6	11	
Cobalt..... "	16	0	0
Columbite.... per unit	—		
Copper H.C. Electro.. ton	203	5	0
Fire Refined 99.70% .. "	202	0	0
Fire Refined 99.50% .. "	201	0	0
Copper Sulphate "	70	0	0
Germanium grm.	—		
Gold..... oz.	12	10	3½
Indium..... "	10	0	0
Iridium..... "	20	0	0
Lanthanum..... grm.	15	0	0
Lead English..... ton	69	0	0
Magnesium Ingots.... lb.	2	5½	
Notched Bar..... "	2	10½	
Powder Grade 4..... "	6	3	
Alloy Ingot, A8 or AZ91 .. "	2	8	
Manganese Metal.... ton	290	0	0
Mercury..... flask	79	0	0
Molybdenum..... lb.	1	10	0
Nickel..... ton	600	0	0
F. Shot..... lb.	5	5	
F. Ingot..... "	5	6	
Osmium..... oz.	nom.		
Osmiridium..... "	nom.		
Palladium..... "	5	15	0
Platinum..... "	23	5	0
Rhodium..... "	40	0	0
Ruthenium..... "	16	0	0
Selenium..... lb.	nom.		
Silicon 98%..... ton	nom.		
Silver Spot Bars..... oz.	6	3	
Tellurium..... lb.	15	0	0
Tin..... ton	730	0	0
*Zinc			
Electrolytic..... ton	—		
Min 99.99%..... "	—		
Virgin Min 98%..... "	63	15	7½
Dust 95/97%..... "	104	0	0
Dust 98/99%..... "	110	0	0
Granulated 99+ % .. "	88	15	7½
Granulated 99.99+ % .. "	101	7	6

*Duty and Carriage to customers' works for buyers' account.

INGOT METALS

Aluminium Alloy (Virgin)	£	s.	d.
B.S. 1490 L.M.5 ton	210	0	0
B.S. 1490 L.M.6 "	202	0	0
B.S. 1490 L.M.7 "	216	0	0
B.S. 1490 L.M.8 "	203	0	0
B.S. 1490 L.M.9 "	203	0	0
B.S. 1490 L.M.10.... "	221	0	0
B.S. 1490 L.M.11.... "	215	0	0
B.S. 1490 L.M.12.... "	223	0	0
B.S. 1490 L.M.13.... "	216	0	0
B.S. 1490 L.M.14.... "	224	0	0
B.S. 1490 L.M.15.... "	210	0	0
B.S. 1490 L.M.16.... "	206	0	0
B.S. 1490 L.M.18.... "	203	0	0
B.S. 1490 L.M.22.... "	210	0	0

Aluminium Alloy (Secondary)	£	s.	d.
B.S. 1490 L.M.1 ton	145	10	0
B.S. 1490 L.M.2 "	155	10	0
B.S. 1490 L.M.4 "	173	10	0
B.S. 1490 L.M.6 "	190	0	0

†Average selling prices for mid July

Aluminium Bronze	£	s.	d.
BSS 1400 AB.1..... ton	207	0	0
BSS 1400 AB.2..... "	—		

Brass	£	s.	d.
BSS 1400-B3 65/35 .. "	139	0	0
BSS 249..... "	—		
BSS 1400-B6 85/15 .. "	—		

Gunmetal	£	s.	d.
R.C.H. 3/4% ton..... ton	—		
(85/5/5/5)..... "	170	0	0
(86/7/5/2)..... "	179	0	0
(88/10/2/1)..... "	227	0	0
(88/10/2/4)..... "	239	0	0

Manganese Bronze	£	s.	d.
BSS 1400 HTB1.... "	165	0	0
BSS 1400 HTB2.... "	—		
BSS 1400 HTB3.... "	—		

Nickel Silver	£	s.	d.
Casting Quality 12% .. "	nom.		
" " 16% .. "	nom.		
" " 18% .. "	nom.		

Phosphor Bronze	£	s.	d.
2B8 guaranteed A.I.D. released..... "	256	0	0

Phosphor Copper	£	s.	d.
10%..... "	229	10	0
15%..... "	236	0	0

*Average prices for the last week-end.

Phosphor Tin	£	s.	d.
5%..... ton	—		

Silicon Bronze	£	s.	d.
BSS 1400-SB1..... "	—		

Solder, soft, BSS 219	£	s.	d.
Grade C Tinmans.... "	343	3	0
Grade D Plumbers.... "	277	3	0
Grade M..... "	376	6	0

Solder, Brazing, BSS 1845	£	s.	d.
Type 8 (Granulated) lb.	—		
Type 9..... "	—		

Zinc Alloys	£	s.	d.
Mazak III..... ton	94	12	6
Mazak V..... "	98	12	6
Kayem..... "	104	12	6
Kayem II..... "	110	12	6
Sodium-Zinc..... lb.	2	6	

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium	£	s.	d.
Sheet 10 S.W.G. lb.	2	8	
Sheet 18 S.W.G. .. "	2	10	
Sheet 24 S.W.G. .. "	3	1	
Strip 10 S.W.G. "	2	8	
Strip 18 S.W.G. "	2	9	
Strip 24 S.W.G. "	2	10½	
Circles 22 S.W.G. "	3	2	
Circles 18 S.W.G. "	3	1	
Circles 12 S.W.G. "	3	0	
Plate as rolled..... "	2	7½	
Sections..... "	3	1½	
Wire 10 S.W.G. "	2	11	
Tubes 1 in. o.d. 16 S.W.G. "	4	0	

Aluminium Alloys	£	s.	d.
BS1470. HS10W. lb.			
Sheet 10 S.W.G. .. "	3	0½	
Sheet 18 S.W.G. .. "	3	3	
Sheet 24 S.W.G. .. "	3	10½	
Strip 10 S.W.G. "	3	0½	
Strip 18 S.W.G. "	3	2	
Strip 24 S.W.G. "	3	10	
BS1477 HP30M. Plate as rolled..... "	2	10½	
BS1470. HC15WP. Sheet 10 S.W.G. lb.	3	6½	
Sheet 18 S.W.G. .. "	4	0½	
Sheet 24 S.W.G. .. "	4	10½	
Strip 10 S.W.G. "	3	9½	
Strip 18 S.W.G. "	4	0½	
Strip 24 S.W.G. "	4	8	
BS1477. HPC15WP. Plate heat treated .. "	3	5½	
BS1475. HG10W. Wire 10 S.W.G. .. "	3	9½	
BS1471. HT10WP. Tubes 1 in. o.d. 16 S.W.G. "	4	11	
BS1476. HE10WP. Sections..... "	3	1	

Beryllium Copper	£	s.	d.
Strip..... "	1	4	11
Rod..... "	1	1	6
Wire..... "	1	4	9

Brass Tubes..... "	1	7½	
Brazed Tubes..... "	—		
Drawn Strip Sections .. "	—		
Sheet..... ton	224	5	0
Strip..... lb.	1	9½	
Extruded Bar..... "	—		
Extruded Bar (Pure Metal Basis)..... "	—		
Condenser Plate (Yellow Metal)..... ton	161	0	0
Condenser Plate (Naval Brass)..... "	172	0	0
Wire..... lb.	2	5	

Copper Tubes..... lb.	1	11½	
Sheet..... ton	232	10	0
Strip..... "	232	10	0
Plain Plates..... "	—		
Locomotive Rods..... "	—		
H.C. Wire..... "	250	5	0

Cupro Nickel	£	s.	d.
Tubes 70/30..... lb.	3	4½	

Lead Pipes (London) .. ton	110	0	0
Sheets (London) "	107	15	0
Tellurium Lead..... "	£6 extra		

Nickel Silver	£	s.	d.
Sheet and Strip 7% .. "	3	5½	
Wire 10%..... "	3	11½	

Phosphor Bronze	£	s.	d.
Wire..... "	3	8½	

Titanium (1,000 lb. lots)	£	s.	d.
Billet over 4" dia.-18" dia. lb.	63/-	64/-	
Rod 4" dia.-.250" dia. .. "	75/-	112/-	
Wire under .250" diam.-.036" diam. "	146/-	222/-	
Sheet 8" x 2" x .250"-.010" thick..... "	88/-	157/-	
Strip .048"-.003" thick.. "	100/-	350/-	
Tube (representative gauge)..... "	300/-		
Extrusions..... "	120/-		

Zinc Sheets, English destinations..... ton	97	0	0
Strip..... "	nom.		

Financial News

Light Metal Statistics

Figures showing the U.K. production, etc., of light metals for May, 1958, have been issued by the Ministry of Supply as follow (in long tons):—

Virgin Aluminium

Production	2,038
Imports	22,617
Despatches to consumers	17,198

Secondary Aluminium

Production	8,714
Virgin content of above	896
Despatches (including virgin content)	8,335

Secondary in Consumption (per cent)

Wrought products	5.1
Cast products	82.7
Destructive uses (aluminium content irrecoverable)	55.6
Total consumption	27.7

Scrap

Arisings	12,094
Estimated quantity of metal recoverable	8,508
Consumption by:	
(a) Secondary smelters	10,399
(b) Other users	1,239

Despatches of wrought and cast products

Sheet, strip and circles	10,836
Extrusions (excluding forging bar, wire-drawing rod and tube shell):	
(a) Bars and sections	2,568
(b) Tubes (i) extruded	272
(ii) cold drawn	438
(c) (i) Wire	1,957
(ii) Hot rolled rod (not included in (c) (i))	316
Forgings	279
Castings: (a) Sand	1,409
(b) Gravity die	3,980
(c) Pressure die	1,434

Foil

1,853

Paste

337

Magnesium Fabrication

Sheet and strip	8
Extrusions	154
Castings	172
Forgings	5

Albright and Wilson

An interim Ordinary dividend of 4 per cent has been declared by Albright and Wilson, industrial chemical manufacturers, on the capital increased by the recent one-for-four capitalization issue (5 per cent was paid last year on the smaller capital). Group trading profits for the half-year to June 30 were £2,453,000 (£2,234,000 for the same period last year) and net profits £793,000 (£664,000).

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

Edmont Metals Limited (608407), 43a Sloane St., S.W.1. Registered July 22, 1958. Nominal capital, £100 in £1 shares. Directors: to be appointed by subscribers.

Lombard Equipment Limited (608922), 80 Lombard Street, Birmingham, 12. Registered July 30, 1958. To carry on

business of brassfounders, engineers, etc. Nominal capital, £3,000 in £1 shares. Directors: Frank W. Harris and John S. Goodare.

James Ford and Partners Limited (608921), 24 The Grove, Gosforth, Newcastle upon Tyne, 3. Registered July 30, 1958. To carry on business of iron masters, founders and workers, brassfounders, blast furnace proprietors, etc. Nominal capital, £10,000 in £1 shares. Directors: Alfred J. Ford, Mrs. Kathleen M. Ford and James R. Steel.

F. S. Cooper Limited (609008), 76 Chapeltown Street, Manchester, 1. Registered July 31, 1958. To carry on business of ironfounders and metal founders generally, etc. Nominal capital, £5,000 in £1 shares. Directors: David F. Cooper and Elizabeth M. Cooper.

Juggins and Co. (Metal Finishers) Limited (609146), 52 Barton Street, Birmingham, 6. Registered August 5, 1958. To take over business of "Juggins and Co." carried on at Birmingham, and to carry on business of polishers, enamellers, sprayers, exhibitors, japanners, lacquerers, etc. Nominal capital, £6,000 in £1 shares. Directors: Thomas J. Casey, Derek T. Casey, Mrs. Winifred D. Casey and Graham P. Casey.

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 26/8/58.

Aluminium	£	Gunmetal	£
New Cuttings	134	Gear Wheels	164
Old Rolled	110	Admiralty	164
Segregated Turnings	90	Commercial	140
		Turnings	135
Brass		Lead	
Cuttings	127	Scrap	60
Rod Ends	122	Nickel	
Heavy Yellow	106	Cuttings	—
Light	101	Anodes	450
Rolled	119	Phosphor Bronze	
Collected Scrap	102	Scrap	140
Turnings	116	Turnings	135
Copper		Zinc	
Wire	174	Remelted	55
Firebox, cut up	165	Cuttings	42
Heavy	163	Old Zinc	30
Light	159		
Cuttings	174		
Turnings	156		
Brazery	136		

LIGHT METALS STATISTICS IN JAPAN (April, 1958)

Classification	Pro-duction	Ship-ment	Stock	Export
Alumina	13,406	18,084	12,079	4,036
Aluminium				
Primary	6,782	6,393	2,808	223
Secondary	1,940	1,905	317	0
Rolled Products	5,789	5,689	1,697	657
Electric Wire	1,269	1,185	1,035	419
Sheet Products	1,531	1,498	923	88
Castings	1,725	—	—	—
Die-Castings	949	—	—	—
Forgings	15	—	—	—
Powder	—	—	—	—
Primary Aluminium (May)	7,477	7,929	2,356	696
Sponge				
Titanium	136	132	778	126
Magnesium	65	65	0.3	0
Secondary	216	211	243	0

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):

Used copper wire	(£178.7.6) 205
Heavy copper	(£174.0.0) 200
Light copper	(£143.10.0) 165
Heavy brass	(£108.15.0) 125
Light brass	(£82.12.6) 95
Soft lead scrap	(£61.0.0) 70
Zinc scrap	(£34.17.6) 40
Used aluminium unsorted	—

France (francs per kilo):

Copper	(£208.17.6) 240
Heavy copper	(£208.17.6) 240
Light brass	(£143.10.0) 165
Zinc castings	(£65.5.0) 75
Lead	(£82.12.6) 95
Tin	(£565.10.0) 650
Aluminium	(£117.10.0) 135

Italy (lire per kilo):

Aluminium soft sheet clippings (new) ..	(£191.10.0) 330
Aluminium copper alloy ..	(£116.0.0) 200
Lead, soft, first quality ..	(£84.12.6) 146
Lead, battery plates ..	(£49.17.6) 86
Copper, first grade ..	(£194.7.6) 335
Copper, second grade ..	(£179.17.6) 310
Bronze, first quality machinery	(£188.10.0) 325
Bronze, commercial gunmetal	(£159.10.0) 275
Brass, heavy	(£130.10.0) 225
Brass, light	(£119.0.0) 205
Brass, bar turnings ..	(£127.12.6) 220
New zinc sheet clippings	(£55.2.6) 95
Old zinc	(£40.12.6) 70

THE STOCK EXCHANGE

Business Has Been Good At Rising Prices

ISSUED CAPITAL	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 26 AUGUST +RISE -FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1958 HIGH LOW	1957 HIGH LOW
£	£			Per cent	Per cent			
4,435,792	1	Amalgamated Metal Corporation ...	21/3	9	10	8 11 6	21/3 17/6	28/3 18/-
400,000	2/-	Anti-Attrition Metal ...	1/6	4	8½	5 6 9	1/6 1/3	2/6 1/6
33,639,483	Stk. (£1)	Associated Electrical Industries ...	53/3	15	15	5 12 9	53/3 46/6	72/3 47/9
1,590,000	1	Birfield Industries ...	54/3 +1/9	15	15	5 10 6	57/- 46/3	70/- 48/9
3,196,667	1	Birmid Industries ...	76/3 +3/3	17½	17½	4 11 9	76/3 55/3	80/6 55/9
5,630,344	Stk. (£1)	Birmingham Small Arms ...	32/3 +1½d.	10	8	6 4 0	32/3 23/9	33/- 21/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5% ...	15/6 +1½d.	5	5	6 9 0	15/7½ 14/7½	16/- 15/-
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6% ...	17/3	6	6	6 19 3	17/3 16/6	19/- 16/6
500,000	1	Bolton (Thos.) & Sons ...	25/- +7½d.	12½	12½	10 0 0	28/9 24/-	30/3 28/9
300,000	1	Ditto Pref. 5% ...	15/6 +6d.	5	5	6 9 0	16/- 15/-	16/9 14/3
160,000	1	Booth (James) & Co. Cum. Pref. 7% ...	20/-	7	7	7 0 0	19/4½ 19/-	22/3 18/9
9,000,000	Stk. (£1)	British Aluminium Co. ...	53/1½ +1/1½	12	12	4 10 6	53/1½ 36/6	72/- 38/3
1,500,000	Stk. (£1)	Ditto Pref. 6% ...	18/10½	6	6	6 7 3	19/3 18/4½	21/6 18/-
15,000,000	Stk. (£1)	British Insulated Callender's Cables ...	46/- +9d.	12½	12½	5 8 9	46/- 38/9	55/- 40/-
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	40/- +6d.	10	10	5 0 0	40/- 29/-	39/- 29/6
600,000	Stk. (5/-)	Canning (W.) & Co. ...	21/- +1/-	25+ *2½C	25	5 19 0	21/3 19/7½	24/6 19/3
40,484	1/-	Carr (Chas.) ...	1/6	25	25	11 13 3X	2/3 1/4½	3/6 2/1½
150,000	2/-	Case (Alfred) & Co. Ltd. ...	4/1½	25	25	12 2 6	4/9 4/-	4/6 4/-
555,000	1	Clifford (Chas.) Ltd. ...	20/- +1/-	10	10	10 0 0	20/- 16/-	20/6 15/9
45,000	1	Ditto Cum. Pref. 6% ...	15/9	6	6	7 12 6	15/10½ 15/7½	17/6 16/-
250,000	2/-	Coley Metals ...	2/9	20	25	14 11 0	4/6 2/6	5/7½ 3/9
8,730,596	1	Cons. Zinc Corp.t ...	51/6 +2/-	18½	22½	7 5 9	51/6 41/-	92/6 49/-
1,136,233	1	Davy & United ...	72/6 +2/2	20	15	5 10 3	72/6 45/9	60/6 42/6
2,750,000	5/-	Delta Metal ...	22/3 +1/-	30	*17½	6 14 9	22/4½ 17/7½	28/6 19/-
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd. ...	35/- +2/-	12½	15B	7 3 0	35/- 22/9	38/6 25/-
750,000	1	Evered & Co. ...	27/3 -6d.	15Z	15	7 6 3	28/3 26/-	52/9 42/-
18,000,000	Stk. (£1)	General Electric Co. ...	36/6 +1/9	10	12½	5 9 6	38/7½ 29/6	59/- 38/-
1,500,000	Stk. (10/-)	General Refractories Ltd. ...	36/3 +2/3	20	17½	5 10 3	36/3 27/3	37/- 26/9
401,240	1	Gibbons (Dudley) Ltd. ...	61/-	15	15	4 18 3	66/3 61/-	71/- 53/-
750,000	5/-	Glacier Metal Co. Ltd. ...	5/6	11½	11½	10 9 3	6/6 5/6	8/1½ 5/10½
1,750,000	5/-	Glynwed Tubes ...	15/3 +10½d.	20	20	6 11 3	15/3 12/10½	18/- 12/6
5,421,049	10/-	Goodlass Wall & Lead Industries ...	25/9 +9d.	13½	18Z	5 1 0	25/9 19/3	37/3 28/9
342,195	1	Greenwood & Batley ...	48/3	20	17½	8 5 9	49/3 45/-	50/- 46/-
396,000	5/-	Harrison (B'ham) Ord. ...	14/- +1½d.	*15	*15	5 7 3	14/- 11/6	16/9 12/4½
150,000	1	Ditto Cum. Pref. 7% ...	19/-	7	7	7 7 3	19/- 18/9	22/3 18/7½
1,075,167	5/-	Heenan Group ...	8/6 +3d.	10	20½	5 17 9	8/6 6/9	10/4½ 6/9
216,531,615	Stk. (£1)	Imperial Chemical Industries ...	33/6	12Z	10	4 15 6	33/9 27/7½	46/6 36/3
33,708,769	Stk. (£1)	Ditto Cum. Pref. 5% ...	16/9 +3d.	5	5	5 19 6	17/1½ 16/-	18/6 15/6
14,584,025	**	International Nickel ...	150 -1½	\$3.75	\$3.75	4 8 9	154½ 132½	222 130
430,000	5/-	Jenks (E. P.), Ltd. ...	8/3 +9d.	27½φ	27½	8 6 9	8/3 6/9	18/10½ 15/1½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5% ...	16/3	5	5	6 3 0	16/9 15/-	17/- 14/6
3,987,435	1	Ditto Ord. ...	40/3 +9d.	10	10	4 19 6	45/3 36/6	58/9 40/-
600,000	10/-	Keith, Blackman ...	21/3 +1/3	17½	15	8 5 0	21/3 15/-	21/9 15/-
160,000	4/-	London Aluminium ...	4/4½ +1½d.	10	10	9 2 9	4/4½ 3/-	6/9 3/6
2,400,000	1	London Elec. Wire & Smith's Ord. ...	47/- +6d.	12½	12½	5 6 6	47/- 39/9	54/6 41/-
400,000	1	Ditto Pref. ...	23/3	7½	7½	6 9 0	23/3 22/3	25/3 21/9
765,012	1	McKechnie Brothers Ord. ...	36/9	15	15	8 3 3	36/9 32/-	48/9 37/6
1,530,024	1	Ditto A. Ord. ...	35/-	15	15	8 11 6	35/- 30/-	47/6 36/-
1,108,268	5/-	Manganese Bronze & Brass ...	11/6 +6d.	20	27½	8 14 0	11/6 8/9	21/10½ 7/6
50,628	6/-	Ditto (7½% N.C. Pref.) ...	5/9	7½	7½	7 16 6	6/3 5/9	6/6 5/-
13,098,855	Stk. (£1)	Metal Box ...	53/9 +3d.	11	11	4 1 9	54/3 41/9	59/- 40/3
415,760	Stk. (2/-)	Metal Traders ...	7/6	50	50	13 6 9	7/7½ 6/3	8/- 6/3
160,000	1	Mint (The) Birmingham ...	20/-	10	10	10 0 0	22/9 19/-	25/- 21/6
80,000	5	Ditto Pref. 6% ...	79/6	6	6	7 11 0	83/6 79/6	90/6 83/6
3,705,670	Stk. (£1)	Morgan Crucible A ...	40/6 +2/-	10	10	4 18 9	40/6 34/-	54/- 35/-
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/xd	5½	5½	6 7 6	17/3 17/-	19/3 16/-
2,200,000	Stk. (£1)	Murex ...	52/- +4/3	17½	20	6 14 9	58/9 47/9	79/9 57/-
468,000	5/-	Ratcliffe (Great Bridge) ...	8/9 +3d.	10	10	5 14 3	8/9 6/10½	8/- 6/10½
234,960	10/-	Sanderson Bros. & Newbould ...	25/6	20	27½D	7 16 9	27/- 24/6	41/- 24/9
1,365,000	Stk. (5/-)	Serck ...	15/3	17½Z	15	3 16 6	15/3 11/-	18/10½ 11/6
600,400	Stk. (£1)	Stone (J.) & Co. (Holdings) ...	63/9 +1/-	18	16	5 13 0	63/9 43/9	57/6 43/9
600,000	1	Ditto Cum. Pref. 6½% ...	23/6	6½	6½	5 10 9	24/3 19/6	21/9 18/9
14,494,862	Stk. (£1)	Tube Investments Ord. ...	57/9	15	15	5 3 9	57/9 48/4½	70/9 50/6
41,000,000	Stk. (£1)	Vickers ...	33/6 +3d.	10	10	5 19 6	33/6 28/9	46/- 29/-
750,000	Stk. (£1)	Ditto Pref. 5% ...	14/3	5	5	7 0 3	15/6 14/3	18/- 14/-
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free ...	21/9	*5	*5	7 1 3A	23/- 21/3	24/9 20/7½
2,200,000	1	Ward (Thos. W.), Ord. ...	80/9 +1/6	20	15	4 19 0	80/9 70/9	83/- 64/-
2,666,034	Stk. (£1)	Westinghouse Brake ...	38/- -3d.	10	18P	5 4 6	40/- 32/6	85/- 29/1½
225,000	2/-	Wolverhampton Die-Casting ...	8/3 +4½d.	25	40	6 1 3	8/3 7/1½	10/1½ 7/-
591,000	5/-	Wolverhampton Metal ...	19/9 +6d.	27½	27½	6 19 3	19/9 14/9	22/3 14/9
78,465	2/6	Wright, Bindley & Gall ...	4/-	20	17½E	12 10 0	4/0½ 3/3	3/9 2/7½
124,140	1	Ditto Cum. Pref. 6% ...	12/- +6d.	6	6	10 0 0	12/- 11/3	12/6 11/3
150,000	1/-	Zinc Alloy Rust Proof ...	3/- +1½d.	27	40D	9 0 0	3/1½ 2/7½	5/- 2/9

*Dividend paid free of Income Tax. †Incorporating Zinc Corp. & Imperial Smelting **Shares of no Par Value. ‡ and 100% Capitalized issue. ●The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. Y Calculated on 11½% dividend. ||Adjusted to allow for capitalization issue. E for 15 months. P and 100% capitalized issue, also "rights" issue of 2 new shares at 35/- per share for £3 stock held. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. φ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits.

